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JOURNAL OF PALEONTOLOGY, VOL. 10, NO. 4, PP. 231–247, PLS. 30–38, JUNE, 1936

A CONTRIBUTION TO THE PHYLOGENY OF THE ORBITOIDAL FORAMINIFERA, WITH DESCRIPTIONS OF NEW FORMS FROM THE EOCENE OF MEXICO

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ABSTRACT

Two new genera and seven new species and varieties are described from the Eocene of Mexico. *Polylepidina* and *Helicolepidina* are shown to be descended from *Amphistegina*, through the new genera *Helicostegina* and *Eulinderina*, by a complete series of transitional forms. The general relationships of the group are briefly discussed, and the possible polyphyletic origin of *Lepidocyclina* adumbrated.

During study of large collections of Tertiary foraminifera made by the geologists of the Mexican Eagle Oil Company, in the states of Veracruz and Puebla, considerable numbers of orbitoid-like forms were encountered which could be referred to no previously described genera. Certain of the new forms were accompanied by examples of *Polylepidina* identified as *P. chiapasensis* Vaughan, and a new variety of that species. A further new species of *Polylepidina* was found to occur at higher horizons with *P. proteiformis* Vaughan. In the upper Eocene a new species of *Helicolepidina* was found in association with *H. spiralis* Tobler. A considerable amount of material was separated, sectioned, measured and photographed, and some of the principal results are embodied in the following account, which is published by permission of the Mexican Eagle Oil Company.

The writers wish to acknowledge the helpful criticism of Dr. W. L. F. Nuttall, who has had considerable experience with Mexican foraminifera and who was kind enough to read the present paper before publication.

The manuscript was received by the editor of the Journal October 16, 1935.

HISTORICAL INTRODUCTION

Most of the pioneer work in the study of the American Tertiary larger foraminifera has been carried out by Henri Douvillé, Joseph A. Cushman, and T. Wayland Vaughan. The first of these, in a series of papers published between 1898 and 1927, described a number of species and discussed their distribution, evolution, and relationships. Vaughan added knowledge of a very large number of species in the period from 1923 to the present time, and described also the new genera *Actinosiphon* and *Polylepidina*, these systematic studies being supplemented by numerous notes on distribution. The only other important contributions from a purely systematic point of view are the publication by Tobler (1922)[1] of the new subgenus *Helicolepidina*, and discussions of classification and evolution of the Orbitoididae and the Nummulitidae advanced by Galloway (1928) and Wengen (1927). The results of all this work have been summarized admirably by Vaughan (1933) and Galloway (1933) in two recent textbooks on the foraminifera.

We here offer a novel hypothesis

[1] See list of references, pp. 246, 247.

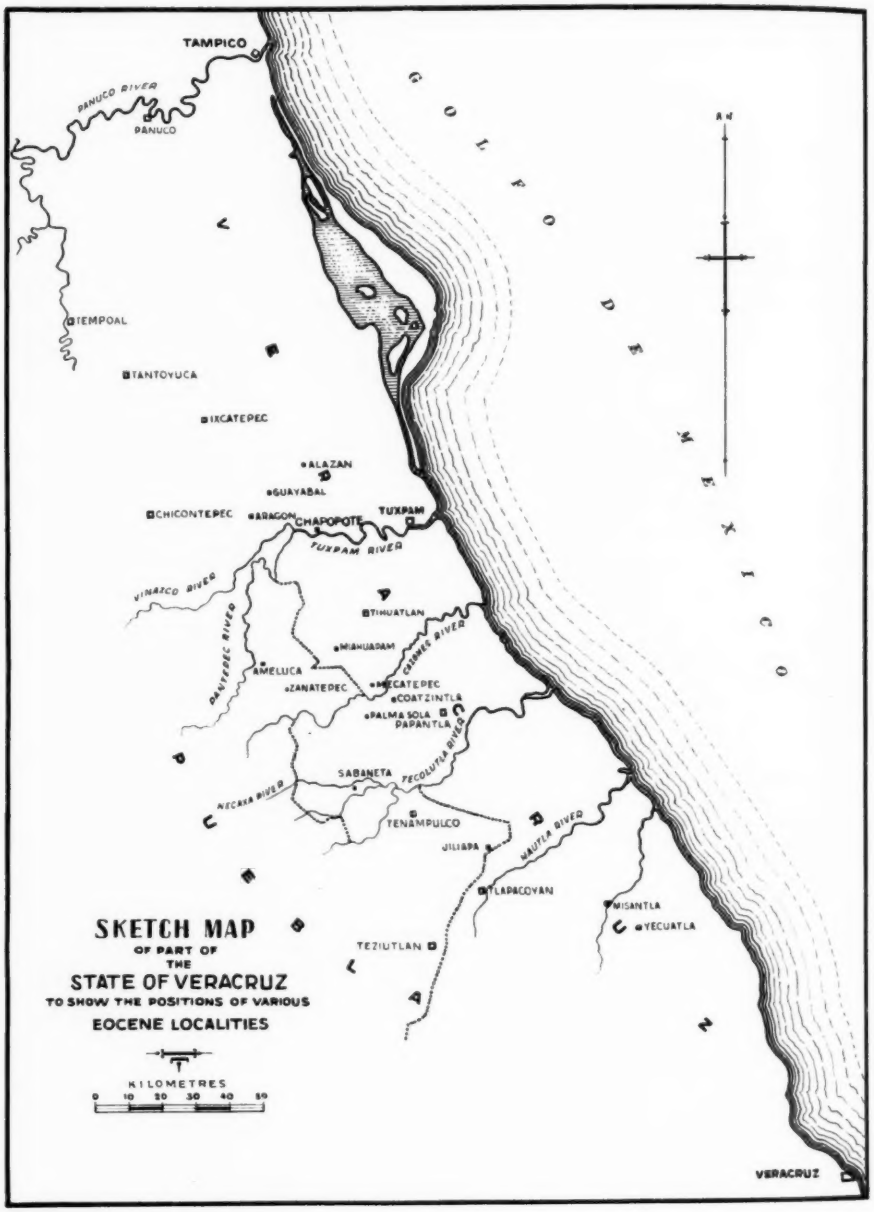

TAMPICO
PANUCO RIVER
PANUCO
TEMPOAL
TANTOYUCA
IXCATEPEC
ALAZAN
GUAYABAL
CHICONTEPEC
ARAGON
CHAPOPOTE
TUXPAM
TUXPAM RIVER
VINAZCO RIVER
TIHUATLAN
DAVEREC RIVER
COZUMEL RIVER
MIAHUAPAM
AMELUCA
ZANATEPEC
NECATEPEC
COATZINTLA
PALMA SOLA
PAPANTLA
TECOLUTLA RIVER
SABANETA
NECAXA RIVER
TENAMPULCO
JILIAPA
MAUTLA RIVER
TLAPACOYAN
MISANTLA
YECUATLA
TEZIUTLAN
VERACRUZ
GOLFO DE MEXICO
SKETCH MAP
OF PART OF
THE
STATE OF VERACRUZ
TO SHOW THE POSITIONS OF VARIOUS
EOCENE LOCALITIES
KILOMETRES
0 10 20 30 40 50

FIG. 1.

of the evolution of *Polylepidina* and *Helicolepidina*, which we undertake to demonstrate by a remarkable series of new types linking these two genera with an *Amphistegina*-like form. This transition is believed to have occurred at the top of the lower Eocene, continuing into the lower part of the middle Eocene where all the main lines of descent in this stock were evolved. All of these genera had died out or had been replaced by descendants belonging to distinct subgenera before the end of the Eocene.

In order adequately to introduce the new forms, the systematic descriptions of genera and species follow immediately, discussion of the classification and relationships being included under the respective genera. In addition, an independent section deals briefly with the general phylogeny of the group.

SYSTEMATIC DESCRIPTIONS[2]

Family ASTERIGERINIDAE d'Orbigny

Genus AMPHISTEGINA d'Orbigny

AMPHISTEGINA LOPEZTRIGOI Palmer

Plate 30, figures 1, 2; Plate 32, figures 1–3; Plate 34, figure 1; Plate 38, figure 3

Amphistegina lopeztrigoi PALMER, *1934*, Soc. cubana hist. nat., Mem., vol. 8 (4), p. 255, pl. xv 6, 8.

Test biconvex, ventral side more inflated than dorsal, both surfaces bearing a cluster of strong pustules on the umbones, grading outwards into radiating ridges along the sutures. Supplementary chambers in the ventral part of the test alternate with the dorsal chambers, the sutures meeting in a zig-zag line just below the periphery, which is acute.

Transverse sections show consecutive chambers connected with one another by slit apertures close to the periphery of the inner whorl, but separated from it by inner portions of the septa, here termed countersepta. Each counterseptum merges into its corresponding septum above and below the aperture, but where it borders the aperture it is curved forward in a strong anteriorly-directed lip, the inner lip, which may be opposed by a much less marked outer lip.

In equatorial section the countersepta with their inner lips appear as forwardly curved hooks against which the septa abut. The septa are recurved with a gentle rather constant curvature.

Remarks.—The type of aperture here described has been observed in other species of *Amphistegina*, and we regard it as probably characteristic of the family Asterigerinidae and related forms. As will be seen, it is found in the new genera *Helicostegina* and *Eulinderina* to be described below.

Amphistegina lopeztrigoi resembles somewhat *Nummulites speciosa* Willard Berry (1929, p. 404, fig. 19). It is highly probable that the latter is an *Amphistegina*, both from the asymmetry of the test as shown by the ornamentation in Berry's figure, and by the fact that material from approximately the same locality in the collection of one of the authors yields an undoubted *Amphistegina* with apparently identical characters.

Locality and Horizon.—The best locality for *Amphistegina lopeztrigoi* is No. 9 in the list of localities on page 247. Lower middle Eocene.

Genus HELICOSTEGINA Barker and Grimsdale, n. gen.

Genotype: *Helicostegina dimorpha* Barker and Grimsdale, n. sp.

[2] For the sake of brevity and ease of reference most of the measurable characters are recorded in the attached tables on pages 236, 239, and 242.

Test multichambered, the earliest chambers coiled in an involute trochoid spire, the chambers of the later coils subdividing ventrally into two or more subsidiary chambers or chamberlets. In the more primitive species (*H. gyralis*, n. sp.) the chamberlets are restricted to the ventral region of the test, upon which they form a continuous layer but in the more specialized form, represented by the genotype, this layer of chamberlets extends peripherally as a more or less undulating compressed flange one cell thick, almost surrounding the early spiral portion which forms excentric umbones on the dorsal and ventral surfaces of the test.

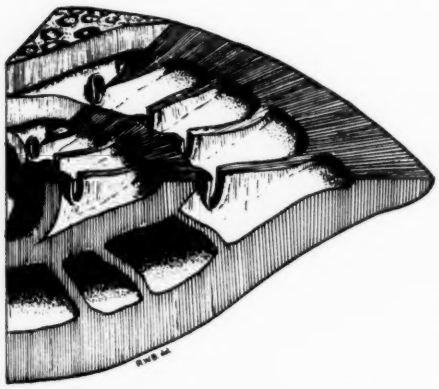


FIG. 2.—Schematic reconstruction of a young specimen of *Helicostegina gyralis*, n. sp., to show the characters of the apertures, etc., ×75.

Consecutive chambers of the spire are separated from one another by recurved septa perforated by peculiar slit apertures, which lie at the inner margins of the septa but do not adjoin the wall of the inner coil; from the latter short processes or countersepta extend to meet the septa, terminating in long anteriorly-directed inner lips (pl. 37, and text fig. 2). Above and below the aperture, the septum and counterseptum are continuous with one another.

The chamberlets of the ventral layer and the chambers of the flange when developed, are separated from one another by curved septa, and communicate by means of cylindrical "stoloniferous passages" arranged in a single tier. The chambers of the flange are indistinguishable in form from the equatorial chambers of *Polylepidina*.

The embryonic apparatus is bilocular, consisting of a subspherical first chamber and a slightly smaller second chamber separated from it by a thin curved septum. The outer walls of the test are perforated by numerous pores; the walls between the chambers of the flange and of the ventral chamberlets are imperforate. There is no canal system.

Ornament is generally present in the

EXPLANATION OF PLATE 30

FIGS. *1*, *2*—*Amphistegina lopeztrigoi* Palmer. *1*, Ventral view; *2*, dorsal view, ×25 (Loc. 9). (p. 233)

3–5—*Helicostegina gyralis* Barker and Grimsdale, n. sp. *3*, Dorsal view; *4*, *5*, ventral views, ×20 (Loc. 3). (p. 236)

6—*Helicostegina dimorpha* Barker and Grimsdale, n. sp., ×19 (Loc. 7). (p. 235)

7–9—*Eulinderina guayabalensis* (Nuttall) var. *regularis* Barker and Grimsdale, n. var. *7*, ×19.2; *8*, ×20.7; *9*, ×18.2. (Loc. 9). (p. 238)

10–12—*Eulinderina semiradiata* Barker and Grimsdale, n. sp., ×15 (Loc. 9). (p. 238)

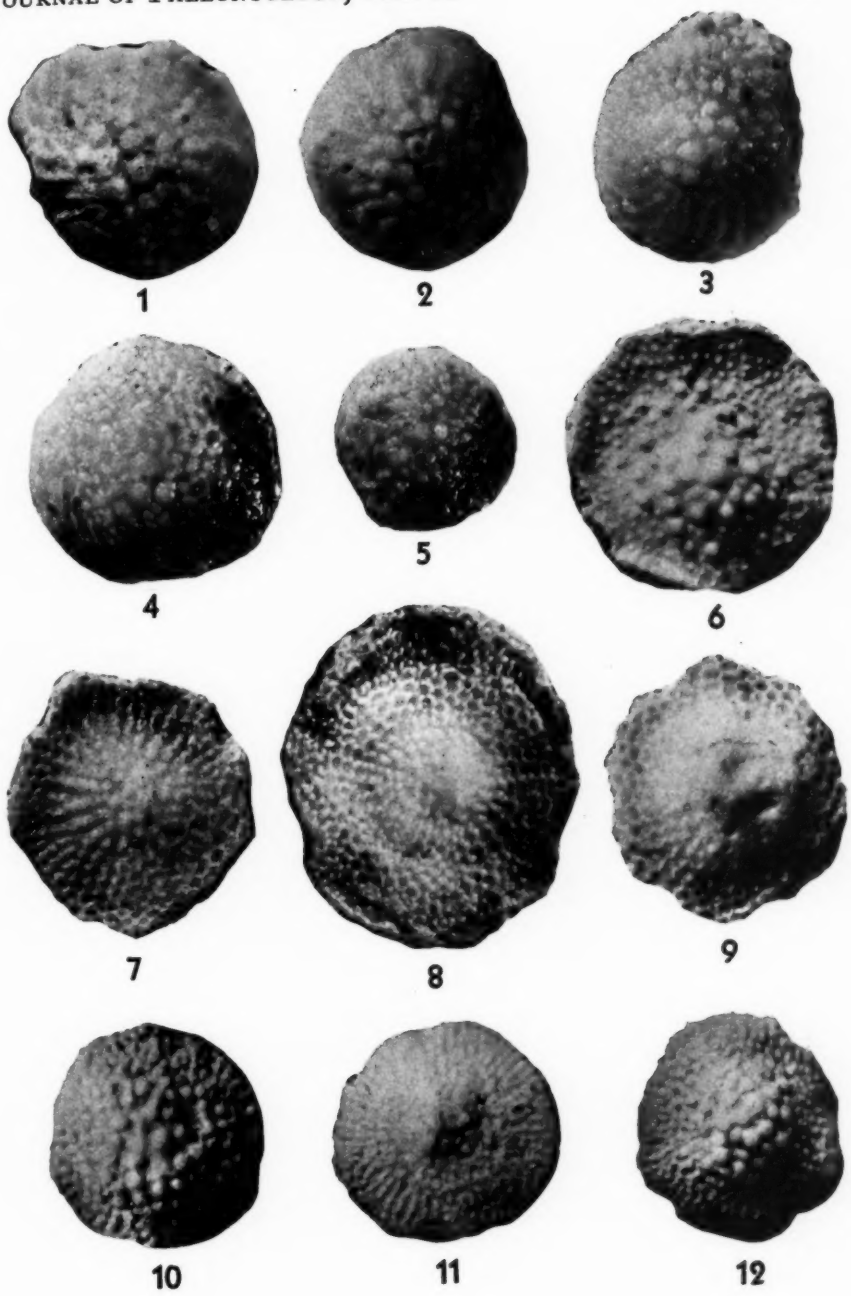
EXPLANATION OF PLATE 31

FIGS. *1*, *2*—*Polylepidina chiapasensis* Vaughan var. *subplana* Barker and Grimsdale, n. var. *1*, ×27; *2*, ×18 (Loc. 1). (p. 241)

3–5—*Polylepidina chiapasensis* Vaughan. *3*, *4*, ×16 (Loc. 6); *5*, ×14 (Loc. 4). (p. 240)

6–10—*Polylepidina discoidalis* Barker and Grimsdale, n. sp. *7*, *9*, Microspheric specimens from Loc. 11, ×3.2; *6*, *8*, *10*, megalospheric specimens from Loc. 5, ×7.5 (p. 241)

11, *12*—*Helicolepidina paucispira* Barker and Grimsdale, n. sp., ×20 (Loc. 8). (p. 243)



Barker and Grimsdale, Eocene Orbitoidal Foraminifera

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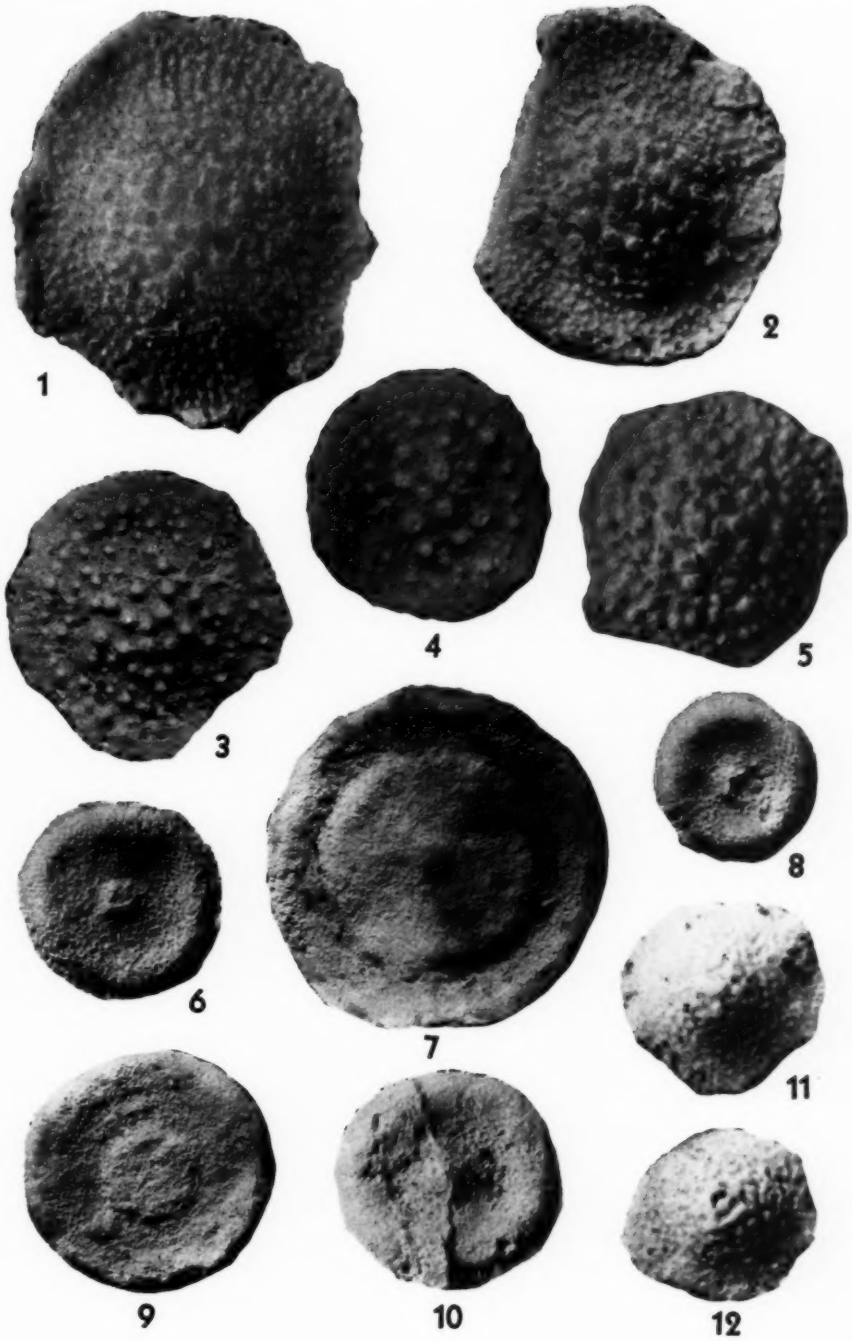

Barker and Grimsdale, Eocene Orbitoidal Foraminifera

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form of papillae, nodes, and costae or raised sutures.

Helicostegina is allied on the one hand with *Amphistegina*, with which genus it has in common the following characters: (1) The form of the spiral portion of the test, with thick outer walls and recurved chambers; (2) the occurrence of subsidiary chambers on the ventral side of the test; (3) the slit apertures with strong anteriorly-directed inner lips; and (4) the bilocular nucleoconch. On the other hand, advanced forms of *Helicostegina* are closely linked with *Helicolepidina*, and through *Eulinderina*, n. gen. with *Polylepidina*. These relationships are discussed later in the accounts of the genera mentioned.

The inclusion of *Helicostegina* in the Asterigerinidae is based upon its resemblance to and relationship with *Amphistegina*, but it may become necessary to remove it to another family where its connection with one lineage of the Orbitoididae will be more apparent.

The position of the genus with regard to such forms as "*Siderolites*" cannot be considered as finally settled without comparison with type material. *Siderolites heracleae* Arni (1932, p. 199, pls. 8–10) from the Senonian of Switzerland shows striking similarity to *Helicostegina gyralis*, but the definite absence of a canal system in the latter seems to exclude possibility of generic or even family identity.

HELICOSTEGINA DIMORPHA Barker and Grimsdale, n. sp.

Plate 30, figure 6; Plate 32, figures 6, 7; Plate 33, figure 9; Plate 34, figures 7, 9; Plate 37, figure 3

Test small, compressed, irregularly undulating, with excentric umbones. Development of surface ornament variable, the spiral portion generally with radiating, more or less broken costae on the sutures, while the flange shows a reticulate pattern corresponding with the septa of the chambers composing it, papillae and tubercles irregularly scattered over the test, with a tendency to be concentrated on the umbones. The flange almost surrounds the spiral portion, which only reaches the periphery in immature individuals in which it forms a sharply keeled border.

Median sections show a bilocular embryo, followed by a primary spire of 14 to 21 curved chambers coiled in one and a quarter to one and a half whorls, bounded externally by a thick spiral wall, the carinate border of immature specimens. Each chamber of the primary spire has but two apertures, by which it communicates with the previously and subsequently formed adjacent chambers. The primary spire is followed in turn by a secondary series of chambers also arranged in a coil, but lacking the thick spiral outer wall. Each of these chambers has three apertures, one connecting it with the previously formed chamber of the spire, another with the next formed chamber of the spire and adjoining the inner wall, the third opening into one of the chambers of the flange, which form an annular series surrounding the secondary spire. The chambers of the flange are polylepidine in form, with four apertures ("stoloniferous passages") to each chamber.

The apertures of the primary spiral are slits with anteriorly directed inner lips.

In transverse sections the trochoid character of the primary spire can be noted, also the derivation of the chambers of the flange from the ventral layer of chamberlets. Slit apertures are visible in the primary spire; cylindrical "stoloniferous passages" between the ventral chamberlets and between the chambers of the flange.

Remarks.—This is the more specialized of the two species here included in *Helicostegina*, and it leads directly to two further specialized genera, *Eulinderina* and *Helicolepidina*.

Locality and Horizon.—Type locality is No. 2 of the list of localities on page 247. Lower middle Eocene.

Table I.—Measurements of Amphistegina lopeztrigoi, Helicostegina gyralis, *and* H. dimorpha.

	Amphistegina lopeztrigoi Palmer	*Helicostegina gyralis* Barker and Grimsdale, n.sp.	*Helicostegina dimorpha* Barker and Grimsdale, n.sp.
Diameter	1.0–1.5 mm.	1.3–2.3 mm.	1–2 mm.
Thickness	0.65–0.8 mm.	0.8–1.1 mm.	0.5–0.6 mm.
Ratio, diameter:thickness	1.5–2:1	2–2.8:1	2–4:1
Ornament	Costae and nodes on sutures	Costae and nodes on sutures	Nodes and papillae
Shape of test	Stout lenticular	Lenticular biconvex	Lenticular flattened
Periphery	Acute	Sub-acute	Flanged
Number of coils in spire	3–3.5	3–5	1.25–1.75
Number of chambers in last coil	18–22	20–25	14–16
Internal diam. of initial chamber	115μ–160μ	110μ–160μ	140μ
Wall thickness of initial chamber	12μ– 25μ	10μ– 30μ	14μ–20μ
Total length of nucleoconch	215μ–230μ	185μ–240μ	260μ
Number of chambers in spire	——	——	16–22

HELICOSTEGINA GYRALIS Barker and Grimsdale, n. sp.

Plate 30, figures 3–5; Plate 32, figures 4, 5; Plate 34, figures 2–6; Plate 37, figure 6

Test biconvex-lenticular to almost planoconvex, the latter form being assumed sometimes by large microspheric individuals. Externally, pustules are present around the central umbones both dorsally and ventrally, extending into low radiating ridges along the sutures.

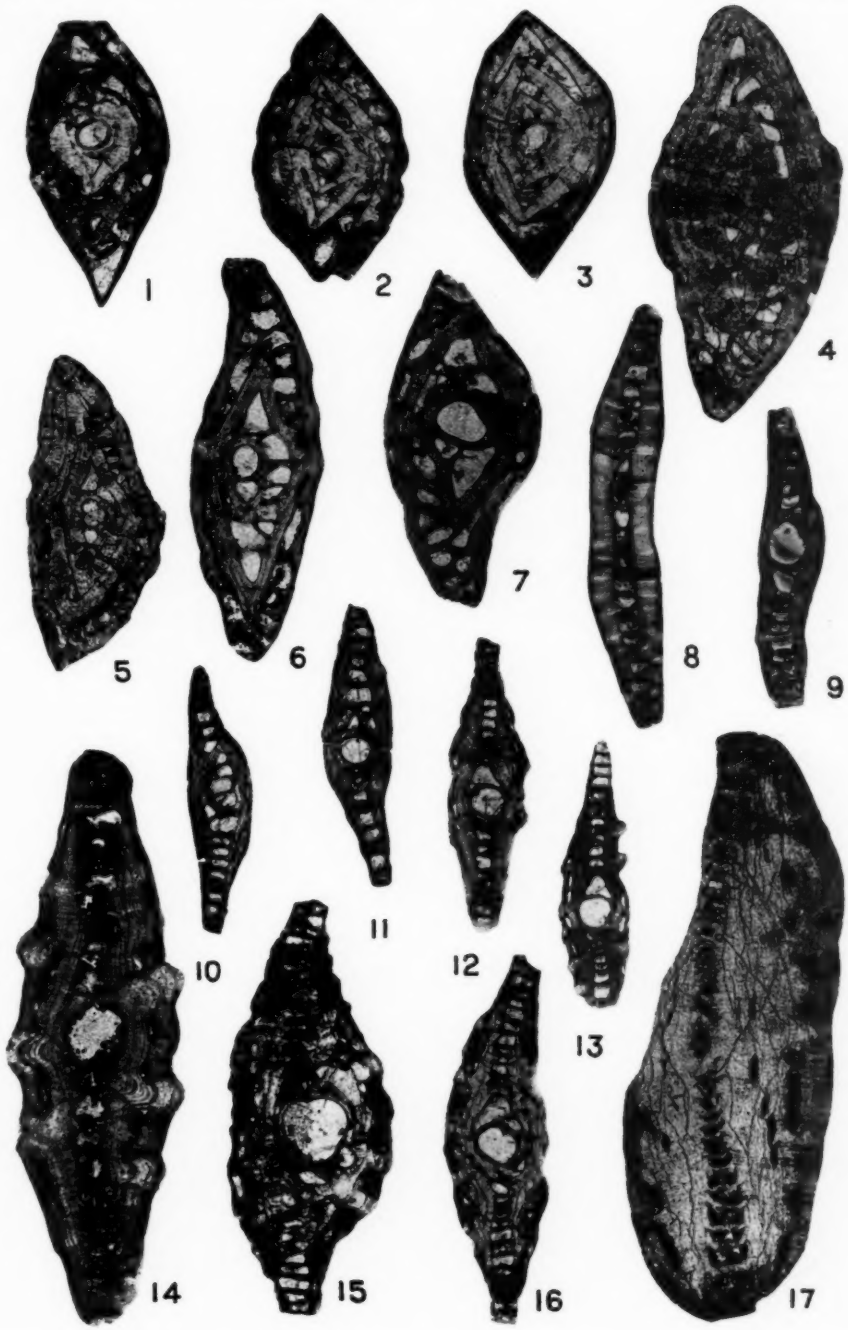
Sections exhibit a bilocular nucleoconch followed by a trochoid spire of from three to five coils, the last coil consisting of 20 to 25 chambers separated from each other by strongly recurved septa. Each coil completely embraces the earlier coils, overlapping on the umbones. On the dorsal side of the equatorial plane, the chambers are simple and undivided: ventrally, and peripherally in the last coil of adult specimens, the chambers are subdivided by curved imperforate partitions into two or more chamberlets or sudsidiary chambers which are somewhat irregular in size and shape.

The chambers of the spire are connected by slit apertures, closely similar to those found in *Amphistegina*. These slits are separated from the wall of the inner coil by countersepta terminating in strong anteriorly directed apertural inner lips, as described for the genus. The

EXPLANATION OF PLATE 32

Transverse sections

FIGS. *1–3—Amphistegina lopeztrigoi* Palmer, ×30.5 (Loc. 9). (p. 233)
4, 5—Helicostegina gyralis Barker and Grimsdale, n. sp., ×27 (Loc. 3). (p. 236)
6, 7—Helicostegina dimorpha Barker and Grimsdale, n. sp., ×37.5 (Loc. 2). (p. 235)
8, 9—Eulinderina guayabalensis (Nuttall). *8*, Microspheric specimen, ×26.5; *9*, megalospheric specimen, ×24 (Loc. 15). (p. 238)
10, 11—Eulinderina guayabalensis (Nuttall) var. *regularis* Barker and Grimsdale, n. var., ×25.5 (Loc. 9). (p. 238)
12, 13—Polylepidina chiapasensis Vaughan var. *subplana* Barker and Grimsdale, n. var., ×21.5 (Loc. 1) (p. 241)
14—Polylepidina chiapasensis Vaughan, ×38 (Loc. 6). (p. 240)
15–17—Eulinderina semiradiata Barker and Grimsdale, n. sp. *15*, Megalospheric specimen, ×25; *16*, megalospheric specimen, ×22.5; 17, microspheric specimen, ×36 (Loc. 9). (p. 238)



Barker and Grimsdale, Eocene Orbitoidal Foraminifera

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ventral subsidiary chambers are connected with one another by means of circular or oval apertures of the kind observed in *Polylepidina*.

Remarks.—Helicostegina gyralis is the more primitive of the two species here referred to that genus. It differs from *H. dimorpha* in the possession of a greater number of whorls in the spire, and in the absence of a flange.

Locality and Horizon.—This species occurs in beds referred to the top of the lower or the base of the middle Eocene; type locality No. 3 in the list on page 247.

Family ORBITOIDIDAE Schubert, 1920

Genus EULINDERINA Barker and Grimsdale, n. gen.

Genotype: *Eulinderina guayabalensis* (Nuttall).

Test compressed lenticular to discoidal, formed generally of a single layer of chambers overlain on both surfaces by variably thick laminae of perforate shell substance which may show irregular interspaces or lateral chambers. A biloc-ular embryo is followed by a few chambers forming a trochoid spiral, which never exceeds one whorl. This spire has a thick outer wall and its chambers are connected by apertures with countersepta and anteriorly directed inner lips. By far the greater portion of the test is composed of arcuate chambers in annular series, having the characters of the median layer chambers of *Polylepidina* which they generally resemble in every respect, varying only in regard to size and regularity of arrangement. In the genotype, irregularity in this respect is exhibited especially by the chambers in proximity to the central spire.

Eulinderina differs from *Helicostegina* (1) in the reduction of the initial spiral which consists of one whorl or less composed of fewer and smaller chambers than in *Helicostegina*, and (2) in the proportionate increase of the annular flange.

Eulinderina closely resembles the primitive forms of *Polylepidina*, from which it differs in the possession of a well-marked trochoid spiral surrounding the nucleoconch, the chambers of the spire being connected by apertures of the *Amphistegina* type, with anteriorly directed inner lips (see text fig. 3).

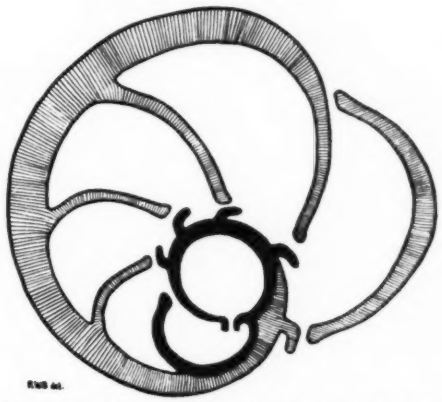


FIG. 3.—Diagrammatic figure of the embryonic apparatus and early chambers of *Eulinderina guayabalensis* (Nuttall), ×97.

"Vacuolar" lateral chambers are only known from one species, *Eulinderina semiradiata*, n. sp.

Eulinderina is closely allied to *Polylepidina* and to *Helicostegina*, and since it obviously cannot be classed with the latter in the Asterigerinidae, the authors prefer to attach it for the present to the Orbitoididae. Its resemblance to genera of the Planorbulinidae led Nuttall to place the genotype in the subgenus *Planorbulinella* of *Planorbulina*, but from this it differs in the following respects: (1) Initial spiral coil, in both megalo- and microspheric individuals, shows a thick spiral wall with peculiar apertures as described for *Helicostegina; Planorbulinella* has a spiral only in the microspheric form, with no trace of inner lips to the apertures. (2) The annular chambers of *Eulinderina* are connected by cylindrical stoloniferous apertures as in *Polylepidina*, these being arranged in one plane near the embryonic apparatus,

and in two planes near the periphery; the diameter of these varies from 8μ to 18μ. The apertures in *Planorbulinella* are elongate elliptical in form, and in a single plane, increasing in size from center to periphery, reaching a size of 50μ. (3) Lateral chambers occur in one species of *Eulinderina*, whereas no species of *Planorbulinella* has been seen to exhibit them.

The remarkable similarity of *Eulinderina* to *Linderina* may be discounted, since the latter is said to lack apertures connecting the annular chambers.

EULINDERINA GUAYABALENSIS (Nuttall)

Plate 32, figures 8, 9; Plate 34, figures 8, 10, 11; Plate 37, figure 4

Planorbulina (*Planorbulinella*) *guayabalensis* NUTTALL, *1930*, Jour. Paleontology, vol. 4, p. 276, pl. 25, figs. 15–17.

Supplementing Nuttall's original description, it may be noted that both megalospheric and microspheric forms occur, the latter with a large and more undulating test, and a tendency to develop papillae on the central portion and in concentric rings.

In section, the *A* form shows a bilocular nucleoconch, followed by a trochoid spire of less than one whorl with a thick outer wall. The spiral arrangement continues for a few more chambers, after which growth becomes annular. The *B* form has a minute spire in the place of the bilocular embryo of the *A* form. In broken or young specimens the thick spiral wall is seen to be a peripheral keel.

The apertures of the spire show countersepta terminating in long anteriorly directed lips.

The annular chambers are greater tangentially than radially, and are quite variable in size. This feature serves to differentiate the typical form of the species from the variety described below. The apertures of the annular chambers are cylindrical, lipped passages, four to each chamber, arranged at first in a single plane, occasionally in two planes towards the periphery. They are not distinguishable in character from those of *Polylepidina*.

EULINDERINA GUAYABALENSIS (Nuttall) var. REGULARIS Barker and Grimsdale, n. var.

Plate 30, figures 7, 9; Plate 32, figures 10, 11; Plate 35, figures 4, 5; Plate 37, figure 5

The variety differs from the typical form in that (1) the amount of thickening of the lateral laminae over the center of the test is increased, (2) the initial spire is more closely coiled, and (3) the form and size of the equatorial chambers are more constant, approximating more closely in character to *Polylepidina*.

Locality and Horizon.—This variety is recorded from Loc. 9, in association with *Amphistegina lopeztrigoi* and *Eulinderina semiradiata*. Lower middle Eocene.

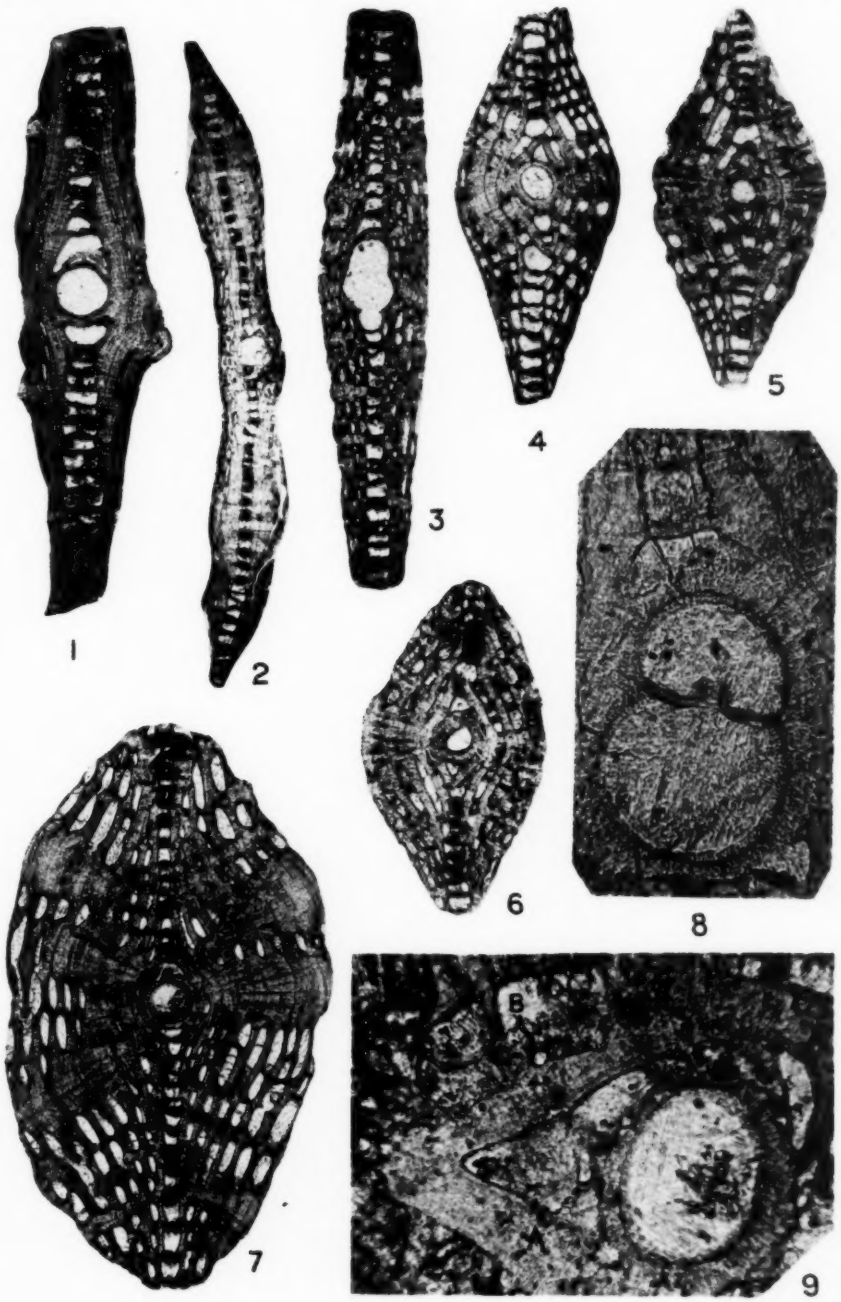
EULINDERINA SEMIRADIATA Barker and Grimsdale, n. sp.

Plate 30, figures 10–12; Plate 32, figures 15–17; Plate 35, figures 1–3; Plate 37, figure 1

EXPLANATION OF PLATE 33

Transverse sections

FIGS. *1*—*Polylepidina chiapasensis* Vaughan, ×33.5 (Loc. 6). (p. 240)
2—*Polylepidina discoidalis* Barker and Grimsdale, n. sp., ×15.5 (Loc. 17). (p. 241)
3—*Polylepidina proteiformis* Vaughan, ×22.5 (Loc. 17). (p. 241)
4–6—*Helicolepidina paucispira* Barker and Grimsdale, n. sp., ×37.5 (Loc. 8). (p. 243)
7—*Helicolepidina spiralis* Tobler, ×35.5 (Loc. 8). (p. 243)
8—*Polylepidina chiapasensis* Vaughan var. *subplana* Barker and Grimsdale, n. var. Transverse section through megalospheric nucleoconch to show aperture, ×145 (Loc. 1). (p. 241)
9—*Helicostegina dimorpha* Barker and Grimsdale, n. sp. Transverse section to show slit aperture in spire (A), and circular foramen in a ventral subsidiary chamber (B), ×135 (Loc. 2). (p. 235)



Barker and Grimsdale, Eocene Orbitoidal Foraminifera

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Test biconvex, the central portion inflated and thickly covered with coarse pustules, marginal portion grading into a flange ornamented with wavy radiating costae.

Equatorial sections show a thick-walled bilocular nucleoconch followed by a short primary spire of from one to three chambers, with a thick outer wall. and a secondary spire rapidly giving place to numerous cycles of chambers of *Polylepidina* type. A few chambers of a connecting link between *E. guayabalensis*, on the one hand, and *Polylepidina* of the type of *P. chiapasensis* Vaughan on the other. From the former it differs in the shortness of the primary spire and in the possession of incipient lateral chambers; from the latter, only in the "*Amphistegina*" apertures in the spire, and the more evidently trochoid form of the initial stages of the test. It is scarcely more than a matter of personal preference whether this species be placed in

Table II.—Measurements of Eulinderina guayabalensis, E. guayabalensis *var.* regularis, *and* E. semiradiata

	Eulinderina guayabalensis (Nuttall)		*Eulinderina guayabalensis* var. *regularis* Barker and Grimsdale, n. var.		*Eulinderina semiradiata* Barker and Grimsdale, n.sp.
	A-form	B-form	A-form	B-form	A-form
Diameter	2.0 mm.	2.5 mm.	1.8–2.2 mm.	To 2.3 mm.	2.0–2.8 mm.
Thickness	0.35 mm.	0.35 mm.	0.4 mm.	——	0.7–0.9 mm.
Ratio, Diameter: Thickness	4:1	6:1	4:1	——	3:1
Number of Coils in Spiral Portion	0.75	2.5	0.5–0.75	2.5	——
Number of Chambers in Spiral	5–7	21–24	4–5	20	1–3
Internal Diameter of Initial Chamber	85μ–115μ	——	120μ	——	180μ–220μ
Thickness of Wall of Initial Chamber	15μ– 25μ	——	20μ	——	Variable
Total Length of Nucleoconch	160μ–230μ	——	220μ–260μ	——	330μ–430μ
Diameter of Spiral	400μ–550μ	250μ	400μ–480μ	370μ	——
Diameter of Apertures	10μ	——	8μ– 10μ	——	15μ– 18μ
Diameter of Pores	3μ	——	4μ	——	5μ
Tangential Diameter of Median Chambers (Periphery)	90μ	120μ	110μ	——	100μ
Radial Diameter of Median Chambers (Periphery)	60μ	70μ	70μ	——	65μ
Wall Thickness of Median Chambers	15μ– 25μ	——	15μ– 25μ	——	25μ– 30μ
Thickness of Roof over Center	80μ– 90μ	100μ–115μ	100μ	——	Variable
Thickness of Roof over Edge of Flange	20μ		15μ– 20μ	——	Variable
Height of Median Layer Chambers (Center)	95μ	95μ	70μ– 80μ	——	100μ–140μ
Height of Median Layer Chambers (Periphery)	150μ	120μ		——	160μ
Height of Embryonic Apparatus	185μ	——	160μ	——	270μ–330μ
Lateral Chambers	Absent		Absent		Incipient vacuolar

the spiral portion invariably show apertures with countersepta terminating in anteriorly directed inner lips. Transverse sections show the equatorial layer to be enclosed on both sides by thick laminae of shell material which form alar prolongations of the equatorial annuli, the laminae being separated from one another at intervals by small irregularly distributed "vacuolar" interspaces or incipient lateral chambers. The surface pustules are the ends of pillars. The initial spiral portion can be seen in both *A* and *B* forms to be trochoid.

Remarks.—Eulinderina semiradiata is *Eulinderina* or *Polylepidina*, and it may in future be advisable to emend the definition of the latter genus to include the whole of *Eulinderina*, possibly as a distinct subgenus. This course would, in our view, necessitate a reclassification of the family Orbitoididae, and it is, therefore, postponed until that task can be satisfactorily performed.

Genus POLYLEPIDINA Vaughan, 1924, emend. Galloway, 1928

Erected by Vaughan (1924) as a subgenus of *Lepidocyclina*. *Polylepidina* was raised by

Galloway (1928) to generic rank, an emendation which we adopt provisionally.

The following list is of species which have been referred by various authors to *Polylepidina:*

Polylepidina adkinsi Vaughan (1924, p. 809, pl. 31, figs. 1–5).

Polylepidina antillea (Cushman) (1919, p. 63, pl. 3, fig. 3).

Polylepidina cardenasensis Galloway (1928, p. 302, pl. 51) = *Lepidorbitoides minima* (H. Douvillé) M. G. Rutten.

Polylepidina chiapasensis Vaughan (1924, p. 807, pl. 30, figs. 1–3; and text fig. 4). Genotype.

Polylepidina? churuguaritana Hodson (1926, p. 27, pl. 7, figs. 7, 8).

Polylepidina gardnerae Cole (1929, p. 4, pl. 1, figs. 1–6; pl. 2, figs. 1, 2).

Polylepidina mirandana Hodson (1926, p. 26, pl. 7, figs. 4–6).

Polylepidina proteiformis Vaughan (1924, p. 810, pl. 32, figs. 1–7).

Polylepidina vanslobbeni M. G. Rutten and Vermunt[3] (1932, p. 238, pl. 1, fig. 11; pl. 2, fig. 9; pl. 3, figs. 3, 4).

Polylepidina variabilis L. Rutten[3] (1928), p. 944, pl. 1, figs. 13–22 and text figs. 24*a–e*).

Polylepidina? vichayalensis L. Rutten[4] (1928, p. 945, pl. 2, figs. 25, 26, and text figs. 24*f–k*, *n–p*), emend. Todd and Barker (1932, pl. 40, figs. 5, 6, and text fig. 4).

Polylepidina zuliana Hodson (1926, p. 25, pl. 7, figs. 1–3).

[3] Vaughan (1933, p. 284) removes these two species from *Polylepidina*, ascribing their multilocular embryos to "gigantisme."

[4] This species may prove to belong in *Helicolepidina*. Classed as *Actinosiphon* by M. G. Rutten.

In addition, the following species must be transferred to the genus: *Polylepidina kinlossensis* (Vaughan) (1928, p. 286, pl. 47, figs. 1–6). Described as a *Pliolepidina*, it probably belongs in the synonymy of *Polylepidina chiapasensis*, of which it is at most a variety.

One new species, *Polylepidina discoidalis*, and one new variety, *P. chiapasensis* Vaughan var. *subplana*, are described below.

Polylepidina chiapasensis Vaughan

Plate 31, figures 3–5; Plate 32, figure 14; Plate 33, figure 1; Plate 35, figures 7, 8

Lepidocyclina (*Polylepidina*) *chiapasensis* Vaughan, *1924*, Geol. Soc. America, Bull., vol. 35, p. 807, text figs. 4*a–e*, pl. 30, figs. 1–3.

This species was originally described from Eocene beds in the State of Chiapas Mexico, and since the original description is a very detailed one, little need be added here. The specimens from the State of Veracruz appear to be consistently smaller than the types, the maximum observed diameter being slightly over 3 mm. as compared with "3.5 mm. –4.0 mm." The state of preservation is excellent, many of the specimens being hollow, allowing ready observation of the apertures and detailed structure.

A further difference from the types may be seen from the table (Table III, p. 242). In the specimens examined the median layer never attains the peripheral thickness quoted by Vaughan, a fact which we believe may be due partly to differences in the amount of wall substance included in the measurement and even more to the larger diameter of the specimens from Chiapas.

Explanation of Plate 34

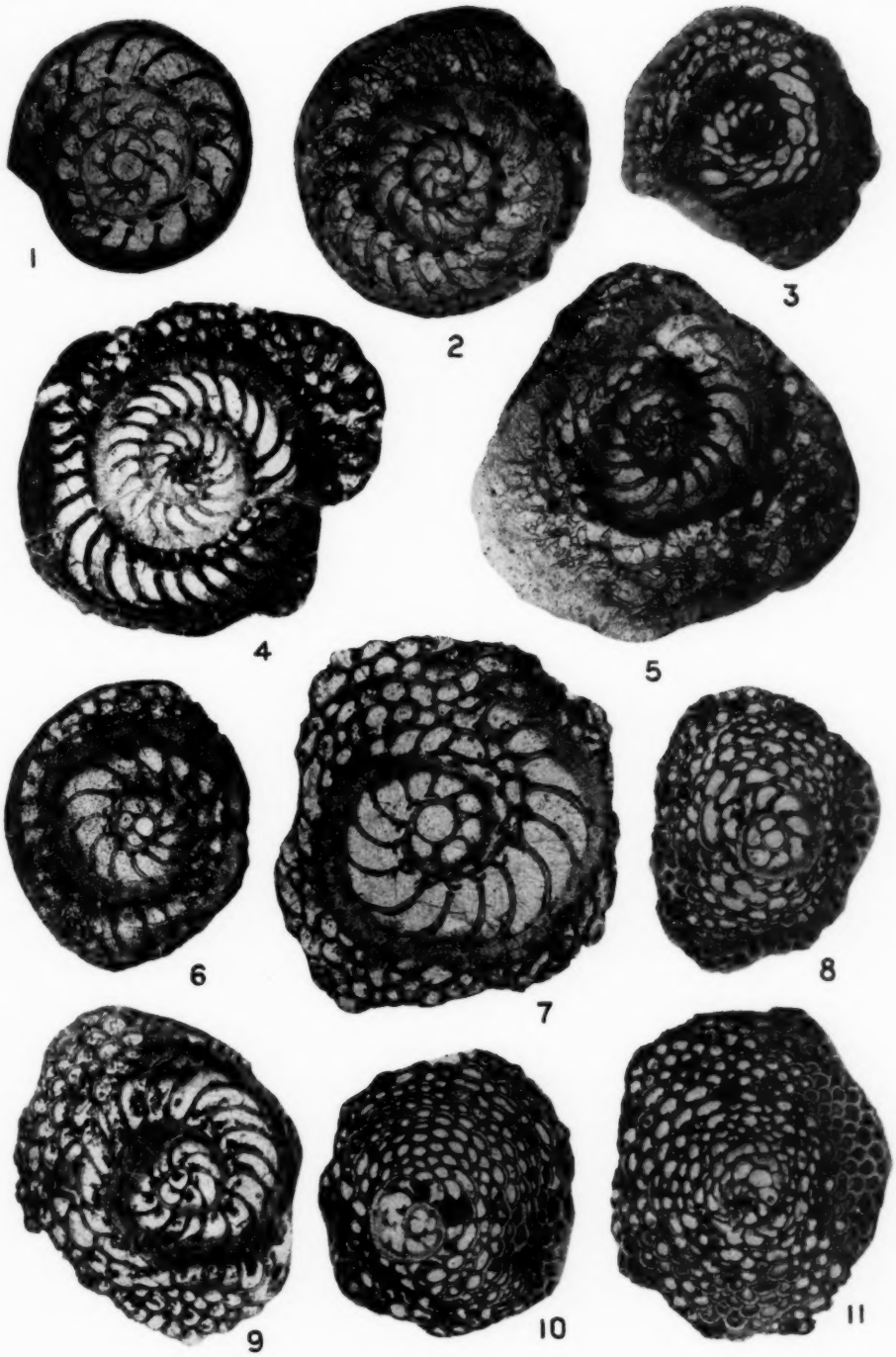
Median sections

Figs. *1*—*Amphistegina lopeztrigoi* Palmer, ×32.5 (Loc. 9). (p. 233)

2–6—*Helicostegina gyralis* Barker and Grimsdale, n. sp. *2*, ×27.5; *3*, ×22.6; *4*, ×22; *5*, ×26.5; *6*, ×27.5 (Loc. 3). (p. 236)

7, *9*—*Helicostegina dimorpha* Barker and Grimsdale, n. sp. *7*, ×37.5; *9*, ×26.5 (Loc. 2). (p. 235)

8, *10*, *11*—*Eulinderina guayabalensis* (Nuttall). *8*, ×24.5 (Loc. 15) (megalospheric); *10*, ×26 (megalospheric topotype from Loc. 14); *11*, ×23 (microspheric specimen from Loc. 15). (p. 238)



Barker and Grimsdale, Eocene Orbitoidal Foraminifera

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This species, which is the genotype of *Polylepidina*, shows considerable differences from other species of the genus, the principal being the thickness of the wall of the embryonic apparatus, and the marked spirality of the early chambers. Stratigraphically and structurally it appears to be the earliest of the genus found in Mexico, and is closely allied to *Eulinderina semiradiata*.

Locality and Horizon.—It is recorded from localities 4, 5 and 6. Lower middle Eocene.

POLYLEPIDINA CHIAPASENSIS Vaughan var SUBPLANA Barker and Grimsdale, n. var.

Plate 31, figures 1, 2; Plate 32, figures 12, 13; Plate 33, figure 8; Plate 35, figure 6; Plate 37, figure 2

The variety differs from the typical form of the species in the more flattened shape of the test, in the finer and more dense pustules on the surface, and in the slightly smaller dimensions of the chambers of nucleoconch and equatorial layer.

Locality and Horizon.—Type locality is No. 1 in the list on p. 247. Lower middle Eocene.

POLYLEPIDINA DISCOIDALIS Barker and Grimsdale, n. sp.

Plate 31, figures 6–10; Plate 33, figure 2; Plate 36, figures 4, 6

Test thin, flat or undulating, annular variations in thickness resulting in concentric raised and depressed regions on both surfaces. In the megalospheric form, the nucleoconch is covered by a central boss, surrounded by a depressed region bounded by a thickened rim, thinning to an acute border: the microspheric form is larger, and has two or three concentric depressions.

The nucleoconch and equatorial chambers are exceedingly like those of *Polylepidina proteiformis* Vaughan. The nucleoconch consists of a large ill-defined first chamber, sometimes showing traces of a septum dividing it into two subequal portions. This chamber is surrounded by a variable number of smaller oval chambers, separated from it by imperfect septa, and in some sections having a rough spiral arrangement; externally to these commence the normal arcuate equatorial chambers. A striking character, which is also shown by *P. proteiformis*, is the extreme thinness of the wall encircling the embryonic apparatus.

Transverse sections show thick laminae of shell substance with irregularly developed lateral chambers almost confined to a narrow zone near the surface of the test. This zone becomes of greater importance in the microspheric form.

The test is generally almost smooth, but may show abundant small papillae.

Locality and Horizon.—This species occurs in the upper middle Eocene, and has been observed in many localities around Tempoal and Tantoyuca; also from near Ameluca, Palma Sola, Sabaneta and elsewhere. It is readily recognizable on its exterior characters.

POLYLEPIDINA PROTEIFORMIS Vaughan

Plate 33, figure 3; Plate 36, figure 5

Lepidocyclina (*Polylepidina*) *proteiformis* VAUGHAN, *1924*, Geol. Soc. America, Bull., vol. 35, pp. 810–812, text fig. 6, pl. 32, figs. 1–7.

Polylepidina proteiformis has been fully described and figured by Vaughan, and since we have compared our material with part of the original collection of Vaughan and Semmes, there is no necessity for a further description here. Figures are included for comparison with *Polylepidina discoidalis*, n. sp.

Genus HELICOLEPIDINA Tobler

HELICOLEPIDINA POLYGYRALIS Barker

Plate 36, figure 2; Plate 38, figures 1, 2

Helicolepidina polygyralis BARKER, *1932*, Geol. Mag., vol. 69, p. 309, pl. 22, fig. 5 and text fig. 4; *1934*, Jour. Paleontology, vol. 8, p. 347, pl. 47, figs. 5–11, text figs. 1 *b*, *e*.

New figures of this species are given for comparison with *Helicolepidina paucispira*, n. sp. described below, also to show the occurrence of incipient coun-

Table III.—Measurements of Polylepidina chiapasensis, P. chiapasensis *var.* subplana, P. kinlossensis, *and* P. discoidalis

	Polylepidina chiapasensis Vaughan (1)	*Polylepidina chiapasensis* Vaughan (2)	*Polylepidina chiapasensis* Vaughan var. *subplana* Barker and Grimsdale, n. var.	*Polylepidina kinlossensis* Vaughan	*Polylepidina discoidalis* Barker and Grimsdale, n.sp.	
					A-form	B-form
Diameter	3.5–4.0 mm.	2.5–3.0 mm.	2.5 mm. av.	5–5.2 mm.	4–5 mm.	Up to 15 mm.
Thickness	0.75 mm.	0.6–0.7 mm.	0.5 mm.	0.75 mm.–1.25 mm.	0.6–0.7 mm.	2.0 mm.
Ratio, Diameter:Thickness	5:1	4:1 app.	5:1	5:1 app.	6–7:1	7:1
Height of Median Layer near the Center	150μ	85μ–100μ	65μ	——	70μ	50μ
Height of Median Layer at the Periphery	250μ	160μ–200μ	120μ–130μ	200μ	140μ	360μ
Height of the Embryonic Apparatus	250μ–300μ	220μ–250μ	150μ–200μ	250μ	270μ	——
Thickness of Pillars at the Surface	100μ	150μ–160μ	50μ– 75μ	To 150μ	——	——
Number of Tiers of Lateral Chambers	3–4	2–3	2	5–6	Variable	Variable
Form of Lateral Chambers	Vacuolar	Vacuolar	Vacuolar	Vacuolar	Vacuolar	Vacuolar
Size of Lateral Chambers	——	40μ×130μ	25μ×90μ	20μ×100μ	18μ×135μ	To 65μ×300μ
Form of Embryonic Apparatus	Sub-spiral	Sub-spiral	One whorl spiral	Spiral to sub-spiral	Multilocular	Spiral
Number of Cells in Embryonic Apparatus	4–5	4–5	6–7	Several	4	14–15
Diameter of Initial Embryonic Chamber	——	——	100μ×130μ to 200μ×230μ	——	——	15μ
Maximum Diameter of Embryonic Apparatus	400μ–450μ	500μ	425μ	To 500μ	500μ–630μ	210μ
Thickness of Embryonic Walls	——	25μ	25μ	——	12μ– 18μ	5μ
Radial Diameter of Median Chambers	50μ–100μ	85μ	65μ	75μ	60μ–100μ	130μ
Tangential Diameter of Median Chambers	125μ–150μ	120μ	100μ	100μ	130μ–150μ	150μ
Thickness of Walls of Median Chambers	——	20μ– 25μ	20μ– 25μ	——	18μ– 25μ	25μ– 35μ
Width of Stoloniferous Apertures	——	15μ– 18μ	12μ– 15μ	——	12μ	——
Diameter of Pores	——	3μ– 4μ	3μ– 4μ	——	4μ	——

(1) = Measurements given in the original description by Vaughan (1924, p. 808).
(2) = Measurements of specimens identified as *P. chiapasensis* by the authors.

Explanation of Plate 35

Median sections

Figs. *1–3—Eulinderina semiradiata* Barker and Grimsdale, n. sp. *1*, ×26.5; *2*, ×25.5; *3*, ×23.5 (Loc. 10). (p. 238)

4, 5—Eulinderina guayabalensis (Nuttall) var. *regularis* Barker and Grimsdale, n. var., ×24 (Loc. 9). (p. 238)

6—Polylepidina chiapasensis Vaughan var. *subplana* Barker and Grimsdale, n. var., ×23.5 (Loc. 1). (p. 241)

7, 8—Polylepidina chiapasensis Vaughan. *7*, ×28.5; *8*, ×24.5 (Loc. 6). (p. 240)

Explanation of Plate 36

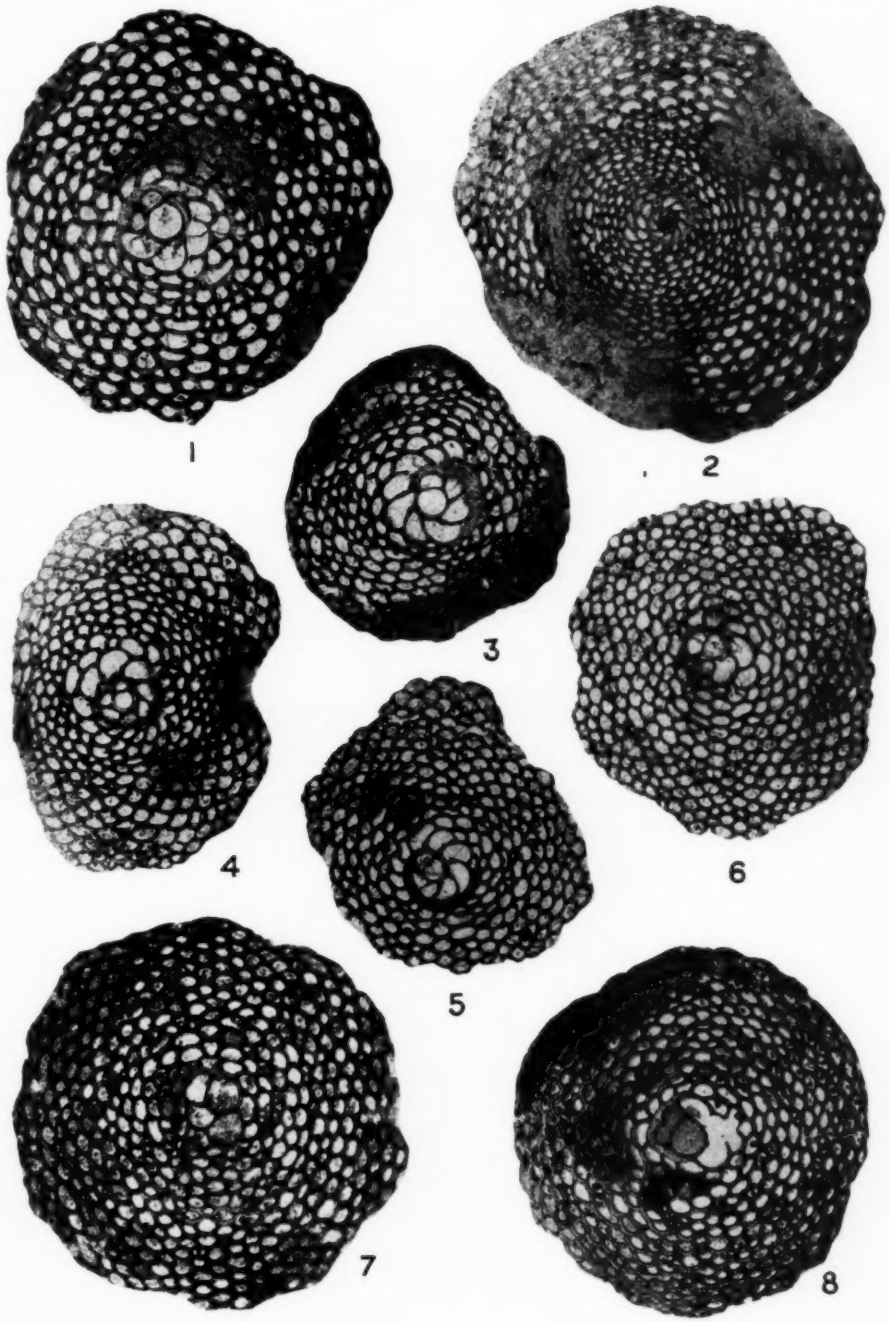
Median sections

Figs. *1, 3—Helicolepidina paucispira* Barker and Grimsdale, n. sp. *1*, ×41.5; *3*, ×42 (Loc. 13). (p. 243)

2—Helicolepidina polygyralis Barker. Microspheric form, ×22 (Loc. 16, Ecuador). (p. 241)

4, 6—Polylepidina discoidalis Barker and Grimsdale, n. sp. *4*, Megalospheric form, ×15.5; *6*, part of microspheric specimen, ×10 (Loc. 18). (p. 241)

5—Polylepidina proteiformis Vaughan, ×29 (Loc. 18). (p. 241)



Barker and Grimsdale, Eocene Orbitoidal Foraminifera

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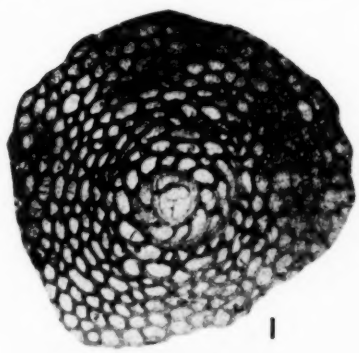

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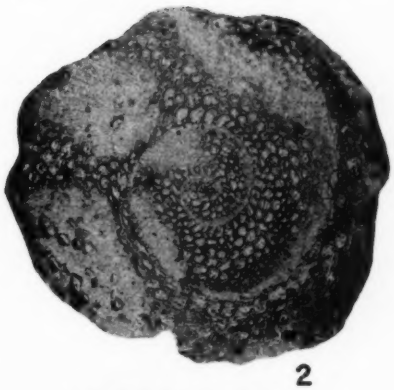

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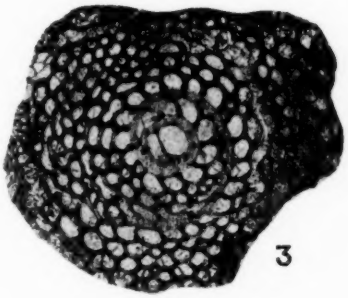

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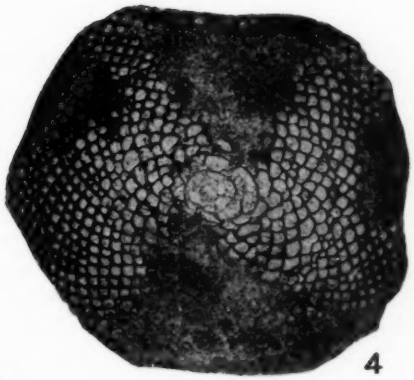

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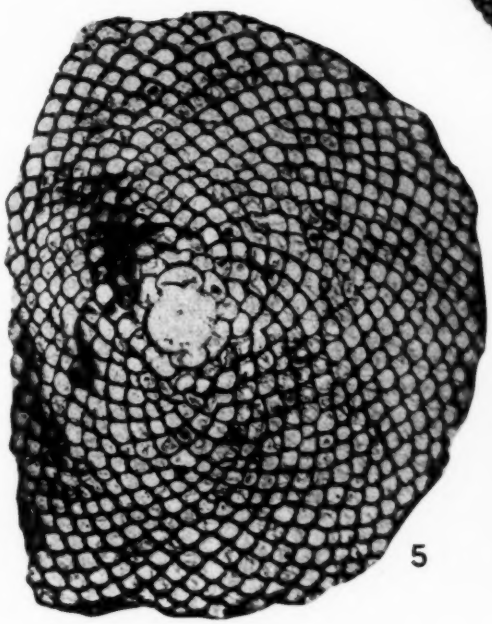

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6

Barker and Grimsdale, Eocene Orbitoidal Foraminifera

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tersepta between the apertures of the spiral chambers and the wall of the inner coil. This is considered to be a primitive character indicating derivation from *Helicostegina*.

HELICOLEPIDINA SPIRALIS Tobler

Plate 33, figure 7

Lepidocylina (*Helicolepidina*) *spiralis* TOBLER, *1922*, Eclogae geol. Helvetiae, vol. 17, p. 380, text figs. 1–3.

Helicolepidina spiralis BARKER, *1934*, Jour. Paleontology, vol. 8, p. 345, pl. 47, figs 1–4, text figs. 1 *a*, *c* (q. v. for further references).

Specimens referred to this species have been noted from several localities near the base of the upper Eocene in the region between the Vinasco River and Misantla in the State of Veracruz. Very large pillars are characteristic of the local race, and a vertical section is here figured for comparison with previously published illustrations of the genus.

HELICOLEPIDINA PAUCISPIRA Barker and Grimsdale, n. sp.

Plate 31, figures 11, 12; Plate 33, figures 4–6; Plate 36, figures 1, 3; Plate 38, figure 4

Test small, lenticular, flanged, with an inflated center bearing irregularly rounded to vermiform bosses corresponding to the terminations of pillars and to the weathered edges of the walls of the lateral chambers.

Equatorial sections show a bilocular nucleoconch consisting of a spherical initial chamber with a smaller crescentic second chamber only about one-quarter embracing, the whole enclosed by a thick wall, and a spiral of chambers forming one to two coils around the nucleoconch, bounded internally by a thick spiral wall which ends abruptly before reaching the periphery. The chambers of the spire are slightly larger than the ordinary median layer chambers which are elongate tangentially and vary in form from arcuate to hexagonal. These show a marked radial arrangement in some sections, the chambers of each radial row alternating with those of the adjacent rows, and increasing fairly uniformly in size towards the periphery where fresh rows are occasionally intercalated. A few clusters of larger chambers may mark the outward continuation of the spire.

The lateral tiers are few in number, and display an equitant character. They are separated from one another by thick floors, the chambers of each tier being separated by thin meandriform walls. Strong central pillars are exhibited by some examples.

H. paucispira differs from other species of the genus in the early disappearance of the spire, which fails to reach the periphery. Only megaspheric forms are yet known.

METAGENESIS[5]

Most of the species described in the preceding account show a clearly marked dimorphism, the microspheric form in general agreeing very closely with the corresponding megalospheric form. Although much material was available, in no case was it possible for us to distinguish more than two forms in any one species, although, as is seen commonly in the larger foraminifera, the megalospheric specimens exhibit considerable variations in measurement.

Each of the microspheric forms is of slightly larger size than its megalospheric equivalent, with a correspondingly increased ratio of diameter to thickness, and a more highly developed spirality in the initial portion of the test. These distinctions appear to be the only ones of any significance.

In a recent description of *Helicolepidina*, one of the authors (Barker, 1934, pp. 348, 349) referred to two microspheric forms, with the sug-

[5] As used by J. U. Todd (1933).

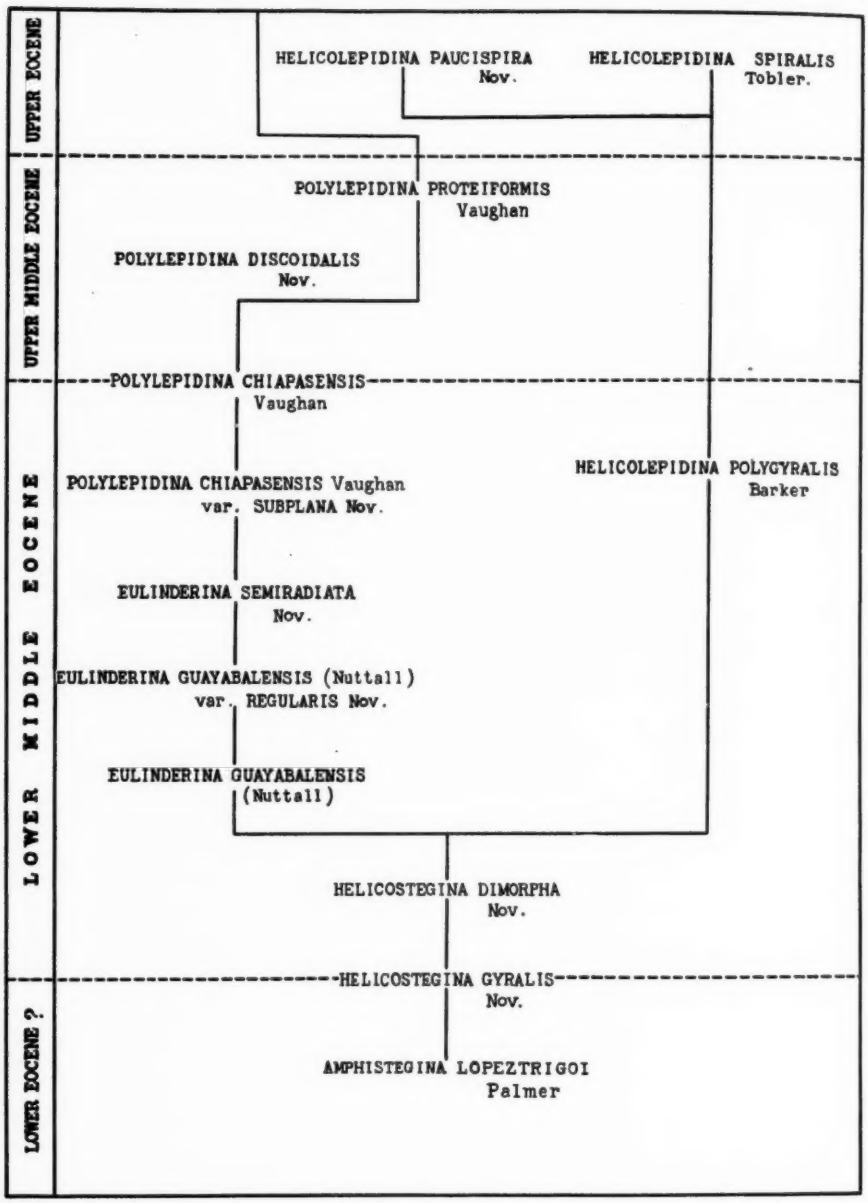


FIG. 4.—Diagram showing inferred phylogenetic relationships of some orbitoidal foraminifera.

gestion that the one showing feeble spirality was the more primitive. In the light of our present knowledge this appears to be incorrect, for if both are truly *Helicolepidina*, then the feebly spiral form must be regarded as the more advanced, showing resemblances to *Polylepidina*.

PHYLOGENETIC CONCLUSIONS

Mention has already been made, in the systematic portion of the work, of the main interrelationships of the various genera there dealt with. The accompanying chart is an attempt to elaborate the ideas expressed above, and to indicate a possible lineage for each of the more pronounced types. Naturally, this attempt cannot be correct in detail. No such "family tree" among fossils ever is, since the radiating nature of continuous variation cannot be fully diagrammed, while unilinear descent is overstressed.

Of the sequence of the genera little more need be said. *Amphistegina lopeztrigoi* is taken as typifying the probable ancestor of the group of genera and species here reviewed. Its actual known occurrence is somewhat later in time than, for example, *Helicostegina gyralis;* but the general similarity in form and structure between these two species leads to a conviction of the closeness of their relationship. The possibility that *A. lopeztrigoi* is a specialized end form, developed by simplification from *Helicostegina* should not be overlooked, however. On the other hand, *Helicostegina* antedates *Eulinderina* which co-exists with early forms of *Polylepidina*, so here the direction of descent is less problematical.

In general the following principal structural characters are to be observed: (1) The appearance of annular growth as a derivative of spiral growth in *Helicostegina;* (2) the reduction of the spire in *Eulinderina*, followed by its disappearance in *Polylepidina;* (3) the persistence of the spiral character in the parallel lineage of *Helicolepidina;* (4) the differentiation of lateral and equatorial zones of chambers in both stocks. All these features are indicated in the various generic descriptions and still more clearly in the illustrations, arranged deliberately to demonstrate them. Application of the doctrines of Recapitulation and of Trends is not considered here, for we believe that a fuller picture is necessary for a discussion of this more philosophical aspect of the matter.

Little will be said of former hypotheses of the evolution of *Polylepidina*. It is obvious that its derivation, postulated by Galloway (1933, p. 422) from *Orbitocyclina*, derived out of *Helicolepidina*, can no longer be upheld. With the prevalent theory that *Lepidocyclina* is descended from *Polylepidina* we are in partial agreement only, since we have evidence of the polyphyletic origin of *Lepidocyclina*. It is hoped to publish a detailed account of the hypothesis at a later date, together

with a full discussion of its bearing upon the classification of the Tertiary genera at present included in the Orbitoididae.[6]

[6] Since writing the above our attention has been drawn to a paper by F. Chapman in which *Amphistegina* is said to possess a canal system (*Zool. Soc. London, Proc.* for 1895, pp. 45–47, pl. i). On page 46 Chapman states that "whilst examining the median sections of *A. radiata*, the presence of true interseptal canals with many branchlets was detected (see fig. 10)." Later he remarks "Upon preparing sections of typical specimens of *Amphistegina hauerina* from the Vienna Basin . . . I found the same well developed canal system."

This is re-stated in his work "The Foraminifera" (1902), where he describes *Amphistegina* as possessing "A fine ramifying canal system present both in the septa and in the shell wall."

Cushman and Galloway in their recent textbooks emphatically state that *Amphistegina* is "without a true secondary canal system." This is supported by Hofker, who, after an exhaustive examination, comes to the conclusion that "though Chapman says that *Amphistegina* possesses a real canal system, there will now be no doubt about the absence of such a system in all *Amphisteginae*" (Siboga Report, Foraminifera, Pt. I, p. 75; 1927).

Furthermore, it may be added that no mention has been made, to our knowledge, concerning the presence of a canal system in *Amphistegina vulgaris* d'Orbigny, which is the genotype of *Amphistegina* nor in the common species *A. lessonii* d'Orbigny. We were quite unable to find any trace of a canal system in specimens of *Amphistegina* examined, and propose to leave the phylogenetic conclusions as stated above until disproved or proved more completely by further research.

REFERENCES

ARNI, P., *1932*, Eine neue *Siderolites* spezies (*S. heracleae*) und Versuch einer Bereinigung der Gattung: *Eclogae geol. Helvetiae*, vol. 25, pp. 199–221, pls. 8–10.

BARKER, R. WRIGHT, *1932*, Larger foraminifera from the Eocene of Santa Elena Peninsula, Ecuador: *Geol. Mag.*, vol. 69, pp. 302–310, pls. 21, 22.

——— *1934*, Some notes on the genus *Helicolepidina* Tobler: *Jour. Paleontology*, vol. 8., pp. 344–351, pl. 47.

BERRY, E. WILLARD, *1929*, The smaller foraminifera of the middle Lobitos shales of northwestern Peru: *Eclogae geol. Helvetiae*, vol. 21, pp. 390–405.

COLE, W. STORRS, *1929*, Three new Claiborne fossils: *Bull. Am. Paleontology*, vol. 15, no. 56, pp. 1–10, pls. 1, 2.

CUSHMAN, JOSEPH A., *1919*, Fossil foraminifera from the West Indies: *Carnegie Inst. Washington, Publ.* 291, pp. 21–71, pls. 1–15.

GALLOWAY, J. J., *1928*, Notes on the genus *Polylepidina* and a new species: *Jour. Paleontology*, vol. 1, pp. 299–303, pl. 51.

———*1928*, Revision of the family Orbitoididae: *Jour. Paleontology*, vol. 2, pp. 45–69.

——— *1933*, *A Manual of the Foraminifera*, Bloomington, Indiana.

EXPLANATION OF PLATE 37

FIGS. *1*—*Eulinderina semiradiata* Barker and Grimsdale, n. sp. Median section of nucleoconch and spire, ×85 (Loc. 10). (p. 238)

2—*Polylepidina chiapasensis* Vaughan var. *subplana* Barker and Grimsdale, n. var. Median section of nucleoconch and spire, ×103 (Loc. 1). (p. 241)

3—*Helicostegina dimorpha* Barker and Grimsdale, n. sp. Median section of nucleoconch and spire, ×135, of specimen figured on Plate 34, fig. 7 (Loc. 2). (p. 235)

4—*Eulinderina guayabalensis* (Nuttall). Section of nucleoconch and spire of specimen figured on Plate 34, fig. 8, ×96 (Loc. 15). (p. 238)

5—*Eulinderina guayabalensis* (Nuttall) var. *regularis* Barker and Grimsdale, n. var. Median section of nucleoconch and spire, ×90 (Loc. 9). (p. 238)

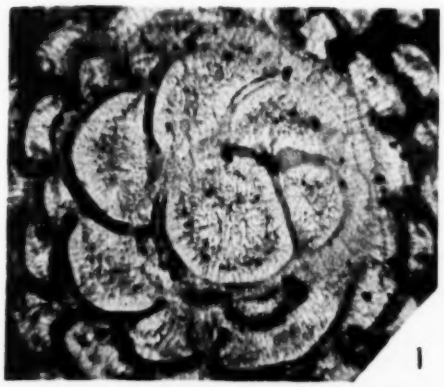
6—*Helicostegina gyralis* Barker and Grimsdale, n. sp. Median section of nucleoconch and first whorl, ×90 (Loc. 3). (p. 236)

EXPLANATION OF PLATE 38

FIGS. *1, 2*—*Helicolepidina polygyralis* Barker. *1*, Megalospheric specimen, ×94; *2*, microspheric specimen, ×95. Median sections of the nucleoconchs and early parts of the spire to show incipient countersepta (Loc 16, Ecuador). (p. 241)

3—*Amphistegina lopeztrigoi* Palmer. Median section of nucleoconch and part of spire of specimen figured on Plate 34, fig. 1, ×90 (Loc. 9). (p. 233)

4—*Helicolepidina paucispira* Barker and Grimsdale. Median section of nucleoconch and part of spire of specimen figured on Plate 36, fig. 3, ×118 (Loc. 13). (p. 243)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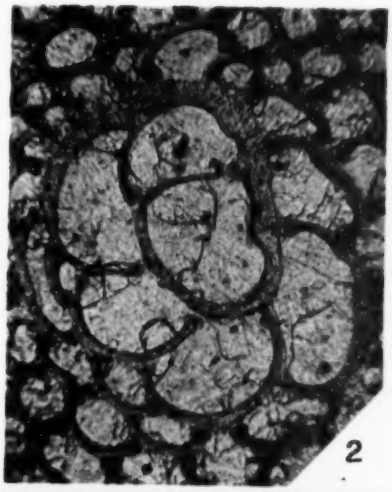
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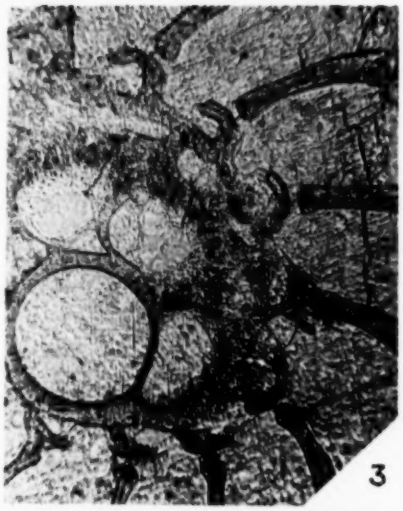
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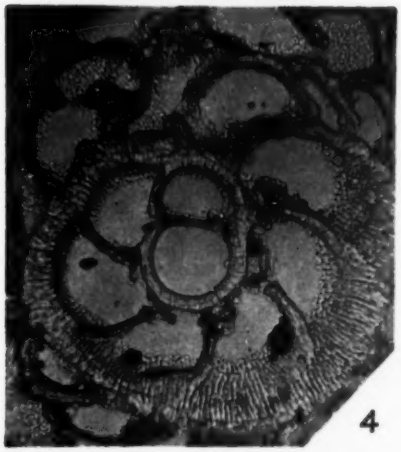
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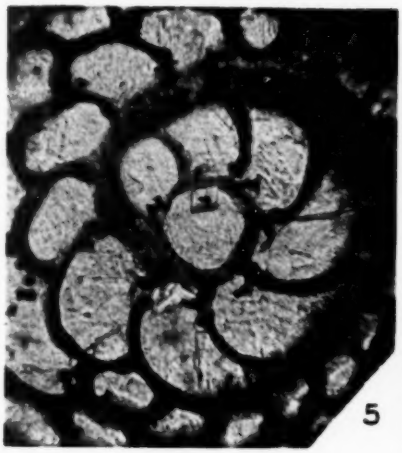
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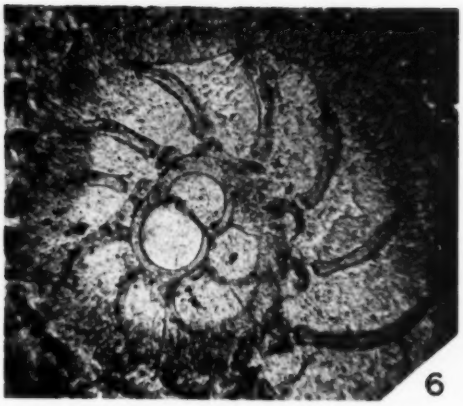
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Barker and Grimsdale, Eocene Orbitoidal Foraminifera

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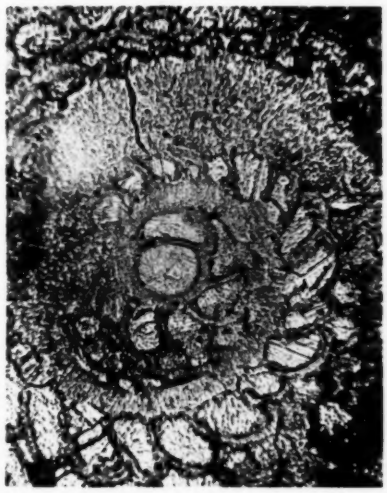

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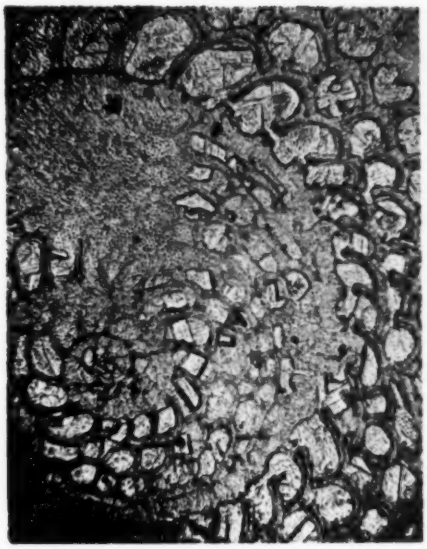

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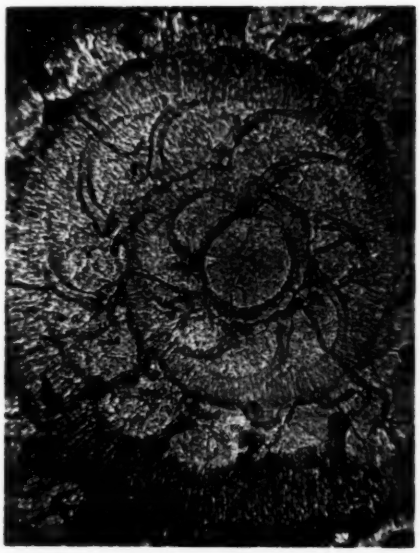

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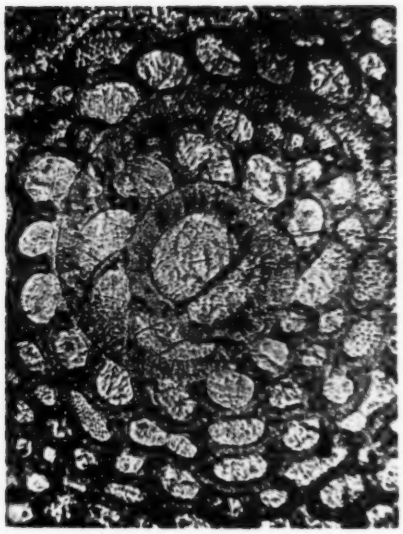

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Barker and Grimsdale, Eocene Orbitoidal Foraminifera

UNIV. OF MICH.

HODSON, HELEN K., *1926*, Foraminifera from Venezuela and Trinidad: *Bull. Am. Paleontology*, vol. 12, no. 47, pp. 1–46, pls. 1–8.

NUTTALL, W. L. F., *1930*, Eocene foraminifera from Mexico: *Jour. Paleontology*, vol. 4, pp. 271–293, pls. 23–25.

PALMER, DOROTHY K., *1934*, Some large fossil foraminifera from Cuba: *Soc. cubana hist. nat., Mem.*, vol. 8, no. 4, pp, 235–264, pls. 12–16, text figs. 1–19.

RUTTEN, L., *1928*, On Tertiary rocks and foraminifera from northwestern Peru: *K. Akad. Wetensch. Amsterdam, Proc.*, vol. 31, no. 9, pp. 931–946, pls. 1, 2.

RUTTEN, M. G., and VERMUNT, L. W. J., *1932*. The Seroe di Cueba limestone from Curaçao: *K. Akad. Wetensch. Amsterdam, Proc.*, vol. 35, pp. 228–240, pls. 1–3.

TOBLER, A., *1922, Helicolepidina*, ein neues subgenus von *Lepidocyclina: Eclogae geol. Helvetiae*, vol. 17, pp. 380–384.

TODD, J. U., *1933*, Metagenesis in *Lepidocyclina: Geol. Mag.*, vol. 70, pp. 393–396.

TODD, J. U., and BARKER, R. W., *1932*, Tertiary orbitoids from northwest Peru: *Geol. Mag.*, vol. 69, pp. 529–543, pls. 39–42.

VAUGHAN, T. WAYLAND, *1924*, American and European Tertiary larger foraminifera: *Geol. Soc. America, Bull.*, vol. 35, pp. 785–822, pls. 30–36.

——— *1928*, Species of large arenaceous and orbitoidal foraminifera from the Tertiary deposits of Jamaica: *Jour. Paleontology*, vol. 1, pp. 277–298, pls. 43–50.

——— *1929*, Studies of orbitoidal foraminifera: Subgenus *Polylepidina* of *Lepidocyclina* and *Orbitocyclina*, a new genus: *Nat. Acad. Sci., Proc.*, vol. 15, pp. 288–295, 1 pl.

———*1933*, In Cushman, J. A., *Foraminifera, their classification and economic use*, 2d ed., chapter on Orbitoididae, pp. 282–301.

WENGEN, W. á, *1927*, Phylogenetic considerations of the Nummulinidae: *Fourth Dutch East Indian Cong. Nat. Sci., Weltevreden (Java), Proc., Geog-Geol. Sect.*, pp. 448–466.

LOCALITIES

1. Five km. E.SE. of Sabaneta, State of Veracruz; Sabaneta lies about 33 km. SW. of Papantla, Veracruz. Collection of Dr. H. Jenny, No. 1531.

2. Nine km. SE. of Sabaneta, State of Veracruz; see Loc. 1. Collection of Dr. H. Jenny, No. 1592.

3. Eleven km. SE. of Sabaneta, State of Veracruz; see Loc. 1. Collection of Dr. H. Jenny, No. 1573.

4. Four km. SW. of Jiliapa, State of Puebla. Collection of Dr. H. Jenny, No. 2054.

5. Six and one-half km. S. of Furbero oil field, near Palma Sola, State of Veracruz. Collection of J. H. Clopton, No. 21.

6. Nine km. S. of Furbero oil field, near Palma Sola, State of Veracruz. Collection of J. H. Clopton, No. 22.

7. Three km. S.SE. of Ameluca, State of Puebla. Collection of Dr. E. A. L. Gevaerts, No. 499.

8. Ten km. E.SE. of Ameluca, State of Puebla. Collection of Dr. E. A. L. Gevaerts, No. 605.

9. Close to village of Yecuatla, State of Veracruz. Collection of Dr. K. T. Goldschmid, No. 837.

10. Same as Loc. 9; collection of Mr. R. W. Barker, No. 77-A.

11. Three km. NE. of Tempoal, State of Veracuz. Collection of Dr. T. Nolthenius, No. 157.

12. Fifteen km. SE. of Tantoyuca, State of Veracruz; in the Hacienda of Santa Maria de Ixcatepec. Collection of Dr. H. Meyer, No. 1025.

13. Eighteen km. SE. of Tantoyuca, State of Veracruz in the Hacienda of Santa Maria de Ixcatepec. Collection of Dr. E. G. Bonnard, No. 1273.

14. Core, Mexican Eagle Oil Company's Mecatepec No. 5 well, 4,590 feet.

15. Union Oil Company's Miahuapam No. 3-A well, mud flush samples between 3,100 and 4,100 feet.

16. Mr. R. W. Barker's collection from Ecuador; Ancon Point, Santa Elena Peninsula, Ecuador.

17. Twenty-two km. S.SE. of Tantoyuca, near Sabana Grande. Collection of Dr. H. Meyer, No. 1517.

18. Fifteen and one-half km. E.SE. of Tantoyuca, in the Hacienda Chila Cortaza. Collection of Dr. H. Meyer, No. 1092.

JOURNAL OF PALEONTOLOGY, VOL. 10, NO. 4, PP. 248–252, PLS. 39, 40, JUNE, 1936

HELICOLEPIDINA NORTONI, A NEW SPECIES OF FORAMINIFERA FROM A DEEP WELL IN ST. LANDRY PARISH, LOUISIANA

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Scripps Institution of Oceanography,
University of California, La Jolla, California

ABSTRACT

A new species of the foraminiferal genus *Helicolepidina*, *H. nortoni*, is described from the Eocene, at a depth of 3,611 to 3,612 feet in a well, in St. Landry Parish, Louisiana, and it is critically compared with *Helicolepidina spiralis* Tobler from the upper Eocene of Trinidad and northern Venezuela. The stolons connecting the chambers in the equatorial layer are described and illustrated. The full complement of stolons from a chamber seems to be six, two on each side of a chamber, and a proximal and a distal radial stolon for each chamber.

Specimens of the species of *Helicolepidina* described below were received from Mr. Richard D. Norton, paleontologist of the Texas Company at Shreveport, Louisiana. They were contained in a core sample from a well in sec. 20, T. 6 S., R. 5 E., St. Landry Parish, at a depth of 3,611 to 3,612 feet. The specimens are interesting, for they represent the first recorded occurrence of *Helicolepidina* in the Tertiary formations of the Gulf Coastal Plain of the United States and supply another instance of the extension of a Caribbean fauna into the southern United States.

HELICOLEPIDINA NORTONI
Vaughan, n. sp.
Plate 39, figures 1–4; Plate 40, figures 1–5

Test lenticular, with strong papillae over the central part. The diameter ranges from 2 to 3.5 mm. The dimensions of the specimens of which vertical sections are illustrated are as follows: The smaller specimen (pl. 40, fig. 2), diameter, 2.67 mm., thickness, 1.2 mm.; intermediate specimen (pl. 40, fig. 1), diameter, 2.8 mm., thickness, 1.7 mm; largest specimen (pl. 40, fig. 3), diameter, 3.56 mm., thickness, 1.73 mm. In these specimens the diameter ranges from slightly more than twice the thickness to 1.6 times the thickness, but some specimens are less inflated, and the central prominence may not be equal in height on each side, one side may be only gently domed, almost flat. The slope from the apex to the margin may be almost straight or it may be slightly excavated, with a peripheral flange. The vertical sections show the thick columns and large surface papillae (pl. 40, fig. 1), one papilla is about 0.53 mm. in diameter, but most of them are much smaller.

There are two embryonic chambers, one larger and nearly spherical; and another smaller chamber, the sides of which lap up on the periphery of the larger chamber, which, therefore, seems to be the initial chamber. The dividing walls between the two chambers is a part of the wall of the larger chamber and is slightly flattened along the contact, but it is still convex toward the smaller chamber. The wall around the two chambers is thick, as much as 30μ. The dimensions of the chambers of four specimens of *H. nortoni* (Nos. 1, 2, 3, 4) and of one specimen of *H. spiralis* (pl. 39, fig. 5) are given on the following page. The measurements are between the outsides of the walls, except that for the smaller chamber the measurements are from the outside of

the outer wall to the surface of the larger chamber to which the smaller chamber is applied.

Some of the thin sections show around the embryonic chambers a girdle of chambers, some of which are slightly larger than the adjacent equatorial chambers, but I could not make out relations to the spiral chambers so definite as those figured by Barker (1934, p. 36). As many as nine of the girdling chambers were counted.

Dimensions of Nucleoconch of Helicolepidina nortoni, *Specimens Nos. 1 to 4, and* Helicolepidina spiralis, *Specimen No. 5.*

Specimen number	Total length	Dimensions of larger chamber	Dimensions of smaller chamber
1	210μ	165×142μ	135× 67μ
2	225	187×142	165× 82
3	270	195×172	180×105
4	270	210×172	180× 90
5	315	240×210	202×105

The equatorial chambers present three types, viz., those within the spiral row of chambers, the spiral row, and those outside the spiral row. The spiral row forms a little more than one complete whorl. Near the center the chambers forming it are not very distinct from the other equatorial chambers of that region, rendering the inner end of the spiral indefinite. Farther out the spiral chambers are clearly differentiated. In general, the outer wall of a chamber in the spiral imbricates on its proximal side over the outer wall of the adjacent chamber. The greater diagonal of a chamber near the periphery is about 114μ; the shorter diagonal, including the walls, is about 95μ. In one place, for a considerable distance the spiral is bounded on its inner side by a continuous wall as much as 76μ thick. There is a similar, but apparently more continuous, spiral wall in *H. spiralis*.

The chambers both within and without the spiral row tend to form radial rows and are mostly hexagonal in shape. Except near the center where the diameter is about 29μ, the radial diameter is shorter than the transverse. Adjacent to the inner side of the spiral chambers, chambers are as large as 114 by 85μ, measured between the middle of the walls, but the chambers vary in size and in the degree of both radial compression and transverse extension. Outside the spiral, the chambers are larger, one on the periphery measuring 190 by 114μ. Passages for stolons can be seen at the sides of some of the chamber walls. Plate 40, fig. 5, illustrates a decalcified Canada balsam preparation of an equatorial section, ×210. This figure shows four stolons, two on each side, at the sides of most chambers. One chamber has two stolons from one corner, the lower left corner of the chamber; and another chamber, the lowest in the figure, has a radial stolon on its proximal side. Six stolons is probably the usual number, two on each side of a chamber, and a proximal and a distal radial stolon. Two stolons may lead to the corners of some chambers.

Vertical sections, ×15, of three specimens are illustrated by Plate 40, figs. 1, 2, 3. The equatorial chambers gradually increase in height from near the embryonic chambers to the periphery, except that in each section, on the right hand side of the figures, one equatorial chamber is larger than the adjacent chamber on each side. This larger chamber apparently is one of the spiral row. Where the layer is thin the height of the chambers is about 50μ; at the periphery it is about 100μ, including the roof and floor. The height of the large chamber, noted above, ranges from about 130 to 170μ.

Apertures for stolons are recognizable in a number of chambers. There is one aperture in a chamber, it is situated near the proximal chamber wall or nearly in the middle between the proximal and distal walls, and its diameter is rather small, about 15μ. Two of them, ×107, are shown on Plate 40, fig. 4.

The lateral chambers occur in definite tiers, with open cavities, the height usually, but not invariably, exceeding the thickness of the roofs and floors, which are very finely perforate. Over the center the number of layers ranges from eight to ten; it decreases toward the periphery, where there may be only one layer, or a very slight edge without lateral chambers. Apertures for stolons are present in some of the vertical walls between the chambers. Very strong pillars are present, especially over the center.

Locality and geologic horizon.—The locality has already been stated in the introductory paragraph. The geologic horizon must be inferred from the known stratigraphic occurrence elsewhere of *Helicolepidina* and from the presence in association with *H. nortoni* of small specimens of a species of *Operculina*, which seems to be *O. vaughani* Cushman (Cushman, 1921, p. 128, pl. 19, figs. 6, 7). Notes on the *Operculina* are as follows:

Plate 39, fig. 6, represents the exterior, ×10, of a specimen, and Plate 39, fig. 7, represents a horizontal section, ×15, of a specimen.

The test is planispiral, thickened over the center, sutures apparently raised. Diameter from outer edge of the aperture through the center, 2.25 mm.; at right angles to a line through the aperture, from 1.75 to 2.0 mm.; thickness through the center, 0.5 mm. Whorls between 2 and 3; 21 chambers in the last coil; chamber walls gently and regularly curved (compare with Cushman, 1921, pl. 19, fig. 7). These specimens are small and perhaps are immature, but they present so many features similar to those of *O. vaughani* that I am tentatively referring them to that species.

From the foregoing remarks, the inference seems warranted that the geologic horizon of *Helicolepidina nortoni* is

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EXPLANATION OF PLATE 39

FIGS. *1–4—Helicolepidina nortoni* Vaughan, n. sp. *1*, Views of exterior of four specimens, ×5. *2*, Views of exterior of four specimens, ×5. *3*, Equatorial section, ×27. *4*, Equatorial section, ×27. (p. 248)

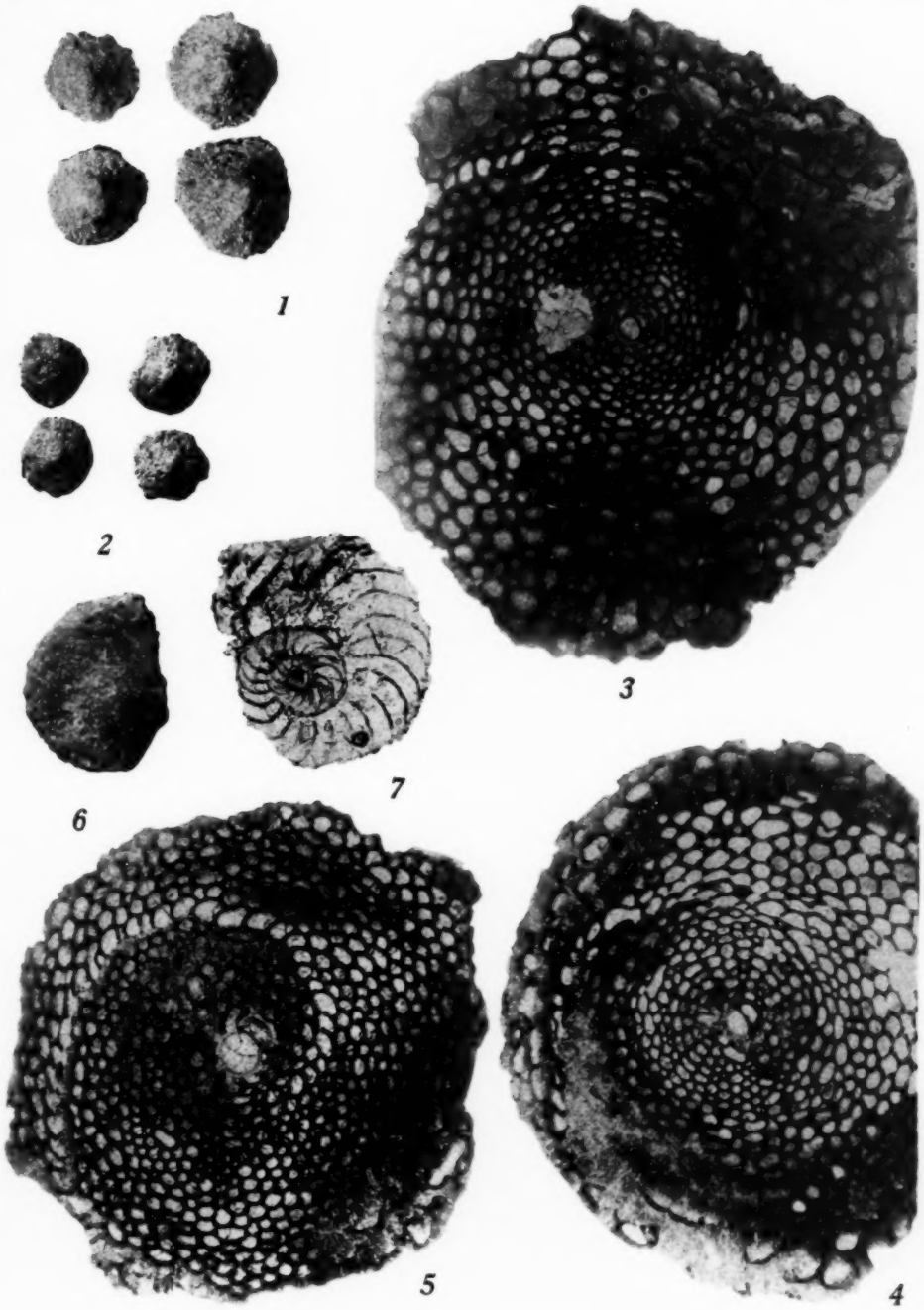
5—Helicolepidina spiralis Tobler, from Soldado Rock, Trinidad. Equatorial section, ×27. (p. 251)

6, 7—Operculina sp. cf. *O. vaughani* Cushman. *6*, View of exterior, ×10. *7*, Median section, ×15. (p. 250)

EXPLANATION OF PLATE 40

FIGS. *1–5—Helicolepidina nortoni* Vaughan, n. sp. *1–3*, Vertical sections of three specimens ×15. *4*, Vertical section, ×107, of the equatorial layer near the periphery of the specimen represented by fig. *3*. This section shows several stoloniferous apertures, two of them are marked by the letter *a* immediately below them. *5*, Decalcified Canada balsam preparation, ×210. The dark areas represent spaces filled with balsam, the light areas represent spaces from which the calcium carbonate skeleton has been removed. (p. 248)

6–8—Helicolepidina spiralis Tobler. *6*, *7*, from Soldado Rock, Trinidad (loc. Kugler, K. 296). *6*, Vertical section, ×27. *7*, Vertical section of the equatorial layer, ×107, near the periphery of the specimen represented by fig. *6*. Each of two chambers, marked by letter *a*, in this specimen shows two apertures. Of the three light-colored spots in a curved tier to the right of the right-hand *a* only the middle spot represents an aperture. The letter *b* is below an aperture through the vertical wall between lateral chambers. *8*, From Cortez Trace, Moruga, Trinidad (loc. Kugler, K. 595). Decalcified Canada balsam preparation, ×210. Dark and light areas as in fig. *5*. Radial stolons are more distinct in other parts of this preparation. (p. 251)



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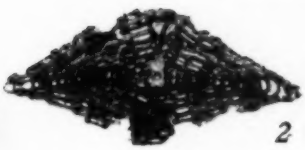

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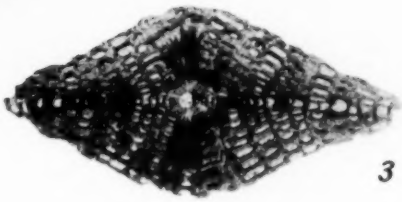

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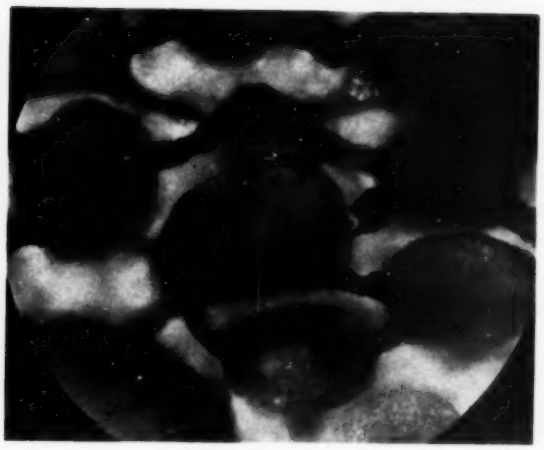

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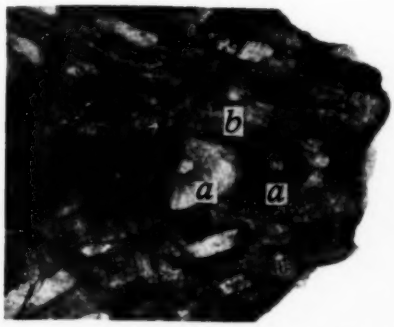

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Vaughan, Eocene Foraminifera

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upper Eocene, in beds equivalent to a part of the Jackson formation and a part of the Ocala limestone, but probably not the top part of those formations.

Comparison and discussion.—Mr. R. Wright Barker has recently summarized knowledge of species of *Helicolepidina* (Barker, 1934), rendering it unnecessary to review the literature in this paper, except to mention that subsequent to Barker's paper, M. G. Rutten has referred *Lepidocyclina* (*?Isolepidina*) *vichayalensis* L. Rutten to *Actinosiphon* Vaughan (M. G. Rutten, 1935). *Helicolepidina polygyralis* Barker has more whorls than *H. nortoni* and therefore it can be eliminated from further consideration. *H. nortoni* is very similar to *H. spiralis* Tobler, the genotype of *Helicolepidina*. Barker (1934, p. 349) presents measurements of species of *Helicolepidina*. The total length of the embryonic apparatus in the horizontal section of *H. spiralis*, for which I give measurements in my table, is 50 per cent longer than the length given by Barker, who gives it as 200μ. In its size and number of whorls, *H. nortoni* is similar to *H. spiralis*, but its form is more like that of *H. polygyralis*. Its pillars appear to differ from those of *H. spiralis* by being larger and by being more restricted to the umbonal region. The principal difference, however, seems to be in the spiral chambers of *H. nortoni*, not extending so clearly to the embryonic chambers as in *H. spiralis*.

In connection with the study of *H. nortoni* I have made a restudy of some of the features of *H. spiralis*, particularly the stoloniferous apertures. Douvillé (1923, p. 568, fig. 2) presents an axial section of *H. spiralis*, ×60, and says, "montrant deux ouvertures de communication que présente chaque logette." In his figure, however, only two chambers show two apertures each, whereas only one aperture is indicated for each of the other chambers. The earlier vertical sections of *H. spiralis* and *H. polygyralis* studied by me did not clearly exhibit the apertures, but an additional section prepared by Dr. W. S. Cole shows them admirably. The larger chambers (pl. 40, fig. 7) show two apertures. These apertures are about 18μ in diameter and are large in comparison with the single apertures present in smaller chambers. The smaller apertures are about 10μ in diameter. Douvillé's figure is essentially correct, but his description needs to be modified as indicated above. I did not find two apertures in a chamber in *H. nortoni*, but the mode of occurrence is similar to that in *H. spiralis*, and the number of apertures per chamber may be one or two, as in *H. spiralis*. In chambers of *Helicolepidina* in which there are two apertures, the apertures do not occur as a pair along a vertical line, as in *Discocyclina* and *Lepidocyclina*, but occur along a radial line.

In addition to the undecalcified vertical section described above, I have studied decalcified balsam impregnations of equatorial sections, a part of one of which is illustrated, ×210, by Plate 40, fig. 8. The stolons between the chamber cavities are similar to those in *H. nortoni*. The complete number in some chambers is six, two on each side, and a proximal and a distal radial stolon.

There are distinct apertures for stolons in the vertical walls between the lateral chambers. One of these is shown on Plate 40, fig. 7, just above the letter *b*, and several other apertures can be recognized.

Acknowledgments.—My thanks are extended to Dr. W. Storrs Cole for making the undecalcified thin sections described and illustrated in this paper, to Mr. Ursel S. Armstrong for making the decalcified balsam preparations, and to them and Mr. E. C. La Fond for making the photographs herewith reproduced.

The manuscript was received by the editor of the Journal October 18, 1935.

Types.—All to be deposited in U. S. National Museum; a duplicate set to be retained for the Scripps Institution of Oceanography, University of California.

REFERENCES

BARKER, R. WRIGHT, *1934*, Some notes on the genus *Helicolepidina* Tobler: *Jour. Paleontology*, vol. 8, no. 3, pp. 344–351, pl. 47.

CUSHMAN, J. A., *1921*, American species of *Operculina* and *Heterostegina* and their faunal relations: *U. S. Geol. Survey, Prof. Paper* 128-E, pp. 125–137, pls. 18–21.

DOUVILLE, H., *1923*, Les Orbitoïdes et leur évolution en Amérique: *Soc. géol. France, Bull.*, 4th sér., tome 23, pp. 369–376, pl. 14, 1923.

RUTTEN, M. G., *1935*, A note on *Actinosiphon vichayalensis* (Rutten): *Jour. Paleontology*, vol. 9, no. 6, pp. 546, 547, 2 figs.

JOURNAL OF PALEONTOLOGY, VOL. 10, NO. 4, PP. 253–259, PLS. 41–43, JUNE, 1936

NEW SPECIES OF ORBITOIDAL FORAMINIFERA OF THE GENUS *DISCOCYCLINA* FROM THE LOWER EOCENE OF ALABAMA

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ABSTRACT

In this paper two new species of *Discocyclina*, *D. blanpiedi* and *D. cookei*, are described from the lower Eocene exposed at Salt Mountain, Clarke County, Alabama, and critical notes are made on and illustrations are given of particular features of *Discocyclina pratti* (Michelin), *D. clarki* (Cushman), *D. psila* Woodring, and *Pseudophragmina floridana* (Cushman) Douvillé.

The specimens on which the following descriptions of *Discocyclina blanpiedi* and *D. cookei* are based were received from Dr. C. W. Cooke, of the U. S. Geological Survey, who collected them in the vicinity of Salt Mountain, Alabama. These species are interesting in that they occur in the lower Eocene. The only other definitely known lower Eocene species of *Discocyclina* so far described from America are three species described by me from Mexico (Vaughan, 1929). They are as follows: *Discocyclina weaveri* Vaughan, *D. weaveri* Vaughan var. *parvipapillata* Vaughan, *D. cristensis* (Vaughan), *D. stephensoni* Vaughan.

Another species, *D. zaragosensis* Vaughan, occurs in either the uppermost lower Eocene or the lowest middle Eocene of the State of Nuevo Leon, near a place known as Los Cigarros, which I recorded incorrectly as Zaragosa. Several middle Eocene species have been described, but it is not necessary to list them here.

Besides the two species described in this paper, Mr. Richard D. Norton, paleontologist of the Texas Company in Shreveport, Louisiana, sent me in December, 1932, specimens of one, possibly two, species of *Discocyclina* contained in a core from Wilson A well of the Alabama Oil and Gas Company, Washington County, Alabama, depth 1178 to 1181 feet. One definable species represented in this material differs from both *D. blanpiedi* and *D. cookei*, and I had hoped to include a description of it in this paper, but that has not been practicable. This note is introduced to call attention to the presence of other species of *Discocyclina* in the Eocene of Alabama.

Doctor Cooke, in his recently published paper, "Notes on the Vicksburg group" (Cooke, 1935, p. 1163) discusses the age of the Salt Mountain limestone and states that

> according to Mr. Blanpied the Salt Mountain limestone occupies a place within the Wilcox group between the Tuscahoma sand and the Nanafalia formation. It was upthrust to its present position adjacent to the Vicksburg group by the Jackson fault.

In my memoir, "The Eocene and Lower Oligocene coral faunas of the

United States," I described two species of corals from the coral limestone at Salt Mountain near Jackson, Alabama. To these I applied the names *Stylophora ponderosa* (Vaughan, 1900, p. 132, pl. 13, fig. 16; pl. 14, figs. 1–1b) and *Turbinaria? alabamensis* (Vaughan, 1900, p. 194, pl. 23, figs. 1–3; pl. 24). Later I identified specimens from the island of Antigua with the first of these species, and I referred the second to the genus *Actinacis*, identifying with it specimens from near Bainbridge on Flint River, Georgia (Vaughan, 1919, p. 206). Although it appears that the two species from Salt Mountain are placed in the proper genera, *Stylophora* and *Actinacis*, it is probable that I was in error in identifying with them specimens from the Oligocene of Antigua and Bainbridge, Georgia. It is not possible at present for me to review the identification of the specimens from Bainbridge and Antigua, but as soon as I can I shall restudy the specimens on which the identifications were based.

Dimensions of the Embryonic Chambers of Discocyclina blanpiedi
(measurements include the walls)

Specimen number	(a) Diameter of smaller chamber	(b) Distance between ends of curved chamber	(c) Distance across both chambers at right angles to (b)
1	82μ	150μ	120μ
2	105	135	150
3	82	135	135

The chamber walls are about 8μ thick and are perforate.

DISCOCYCLINA BLANPIEDI Vaughan, n. sp.

Plate 41, figures 1–7

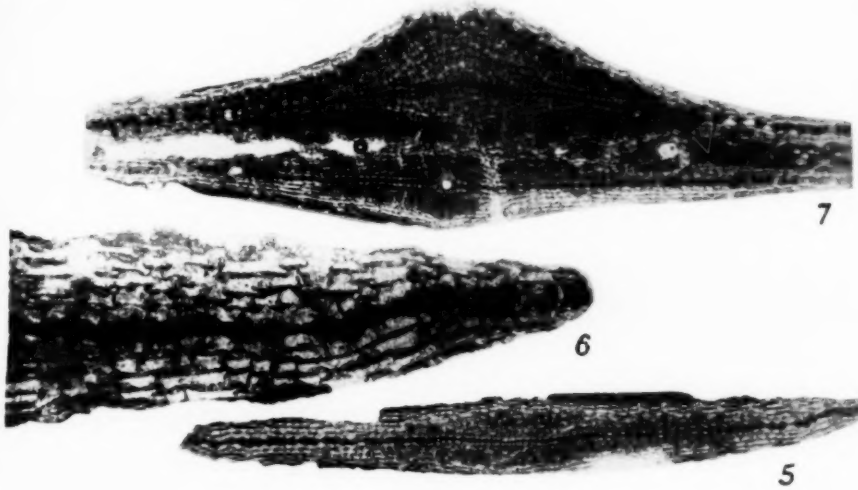
Test discoid, small, thin, wafer-like, with or without a slight umbonal thickening over the center, surface finely granulate. Diameter, 3 to 4 mm.; thickness about 0.7 mm., less than 1 mm.; diameter about five times the thickness. Granules range from about 20μ to about 50μ in diameter.

The embryonic chambers are composed of an inner spherical chamber which is partly embraced by a curved outer chamber. The dimensions of the chambers are given in the above table.

EXPLANATION OF PLATE 41

FIGS. *1–7*—*Discocyclina blanpiedi* Vaughan, n. sp. *1*, Exteriors of four specimens, ×5. *2*, Exterior, ×10, of the largest specimen represented by fig. *1*. This figure shows the granules on the surface of the test. *3*, Equatorial section, ×15. *4*, A part of the chambers in the equatorial layer, ×85, of the specimen represented by fig. *3*. Note that some radial chamber walls do not reach the annular wall on the proximal side of the chambers. *5*, Vertical section of specimen, ×27. *6*, Right-hand periphery, ×85, of specimen represented by fig. *5*. Note the height of the equatorial chambers at the periphery. *7*, Vertical section, ×27, of two specimens, the upper one of which is umbonate and shows pillars over the central part of the test. Note the distinctness of the equatorial layer. (p. 254)

8—*Discocyclina pratti* (Michelin) Schlumberger, from Biarritz, France. Equatorial chambers as seen in a horizontal section, ×85. Note that the radial chamber walls do not all reach the annular chamber wall on the proximal side of the chambers.



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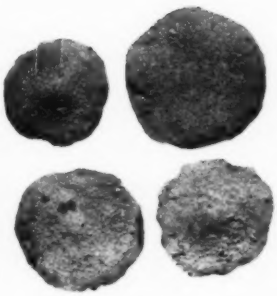

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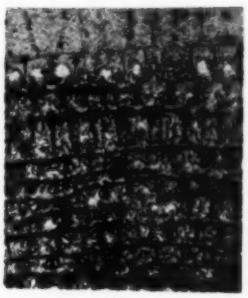

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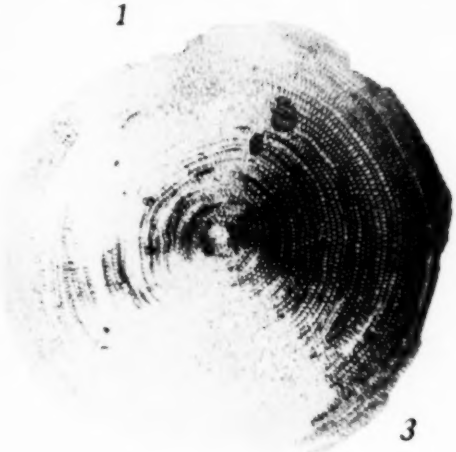

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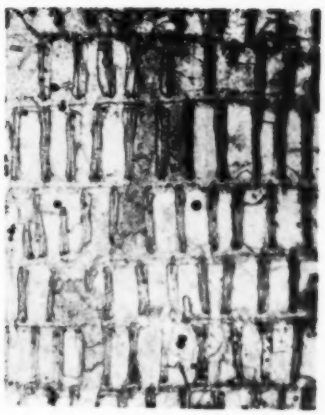

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The equatorial chambers form rather regular annuli, increasing in radial diameter from about 22μ near the center to as much as between 45 and 50μ near the periphery, but some of the distal annuli are narrower. In the specimen illustrated by Plate 41, fig. 3, there are about 54 annuli in 2 mm., an average distance across an annulus of 37μ. The transverse diameter of the chambers is nearly the same as or only slightly greater than the radial diameter. The chambers are nearly square. The chamber walls in adjacent annuli alternate in position. The thickness of the chamber cavities in the equatorial layer near the center ranges from about 8 to perhaps 16μ, gradually increasing toward the periphery; at and near the periphery there is a sudden increase to as much as 50μ. Although the equatorial layer is thin in the central part of the test, the chamber cavities are recognizable up to or almost up to the embryonic chambers. This distinctness of the chamber cavities of the equatorial layer constitutes an important difference between *D. blanpiedi* and *D. cookei*. The roofs and floors range from 20 to 30μ thick.

The chamber communications present significant features. Although there have been secondary infiltration and recrystallization in the specimens, it can be seen that there were annular stolons at the proximal ends of the radial chamber walls, and that the median dark line in each radial chamber wall merges with the annular dark line at the distal ends or sides of the chambers (see pl. 41, fig .4). The communication between the chambers is similar to that in *Discocyclina pratti* (Michelin) (see pl. 41, fig. 8), and not as in *D. psila* Woodring (see pl. 42, fig. 7).

The lateral chambers are irregular in size, shape, and arrangement. They appear as slits, as much as 112μ long and 7μ high, separated by roofs and floors as much as 23μ thick, or as small elliptical or irregularly shaped cavities. The roofs and floors in places are 30μ thick and the slits may be only 3 or 4μ in height. The chamber cavities are more open near the outer surfaces. There is some imbrication of the ends of segments of the roofs, a process from the distal end of a segment projecting below the proximal end of the next outer segment of the roof. There are occasional irregularly developed pillars. Pillars are better developed in the more umbonate variants. On the outer surfaces of the roofs there are distant, irregularly distributed granules, which range approximately from 15 to 40μ in diameter.

A precise count of the number of layers of chambers is not practicable, but it seems that over the center the number ranges from about eight to about eleven.

Syntypes.—Two horizontal and two vertical sections, and four specimens mounted on cardboard, from an underground spring at the N.W. corner S.W. $\frac{1}{4}$ S.W. $\frac{1}{4}$ sec. 34. T. 6 N., R. 2 E., Clarke County, Alabama, three-quarters of a mile north of Salt Mountain, deposited in the U. S. National Museum. Collected by C. W. Cooke.

Other locality.—Salt Mountain, 6 miles south of Jackson, Clarke County, Alabama, collected by B. W. Blanpied and C. W. Cooke.

Variation.—A variation presented by a specimen from the type lot of specimens consists in its being umbonate and in its having well-developed, fairly thick pillars, which are larger over the center. Otherwise, the features are similar to those of the vertical sections of syntypes. This specimen and another specimen cemented to it are illustrated by Plate 41, fig. 7.

Geologic horizon.—According to Mr. Blanpied, as has already been stated, the horizon is in the lower Eocene Wilcox group, between the Tuscahoma sand and the Nanafalia formation.

Comparisons.—Since *D. blanpiedi* occurs in lower Eocene deposits, comparison with upper Eocene species of somewhat similar appearance is scarcely necessary. Therefore, comparisons will be made only with *D. clarki* (Cushman) from the Meganos group of the Eocene,

north of Coalinga, and from beds bordering Simi Valley, referred by B. L. Clark to the Domengine formation (Schenck, 1929, p. 221, pl. 27, figs. 1, 2, 5, text fig. 7; Woodring, 1930, p. 150); and *D. psila* Woodring from the Domengine horizon of the middle or later lower Eocene of the Santa Ynez Range, near Santa Barbara, California (Woodring, 1930, p. 148, and 1931, p. 374). Fortunately, both *D. clarki* and *D. psila* are represented by excellent preparations in the collections of the Scripps Institution, and illustrations of them are introduced for comparisons. In both *D. clarki* (pl. 43, fig. 1) and *D. psila* (pl. 42, fig. 7) the annular stolon is on the distal side of the equatorial chambers, whereas in *D. blanpiedi* the annular stolon is on the proximal side of the chambers, as in *D. pratti*. It seems probable that species referred to *Discocyclina* (*Discocyclina*) will have to be placed in two different genera on the basis of the position of the annular stolons. In the genotype the annular stolons are on the proximal side of the chambers as in *D. blanpiedi;* but in *D. perpusilla* Vaughan (Vaughan, 1929, p. 9, pl. 2, figs. 3–5*a*), *D. clarki* (Cushman) and *D. psila* Woodring, the annular stolons are on the distal side of the chambers.

Besides the fundamental structural difference between species, noted above, there are other differences. *D. clarki* (pl. 43, fig. 2) is larger than *D. psila* (pl. 42, fig. 8) and *D. blanpiedi*, the granulations or papillae on the surface are coarser, and the cavities of the lateral chambers are more open. *D. psila* is similar to *D. blanpiedi* in size, shape, and surface ornamentation. The vertical sections are also similar, but there are differences in the horizontal sections. The nucleoconch of *D. psila* is 160 to 170μ in diameter; that of *D. blanpiedi*, about 115μ; and the equatorial chambers of *D. psila* are radially more elongate than those of *D. blanpiedi*.

Although *D. blanpiedi* externally looks like other species of *Discocyclina*, the details of its inner structure show that it is very different.

DISCOCYCLINA COOKEI Vaughan, n. sp.

Plate 42, figures 1–6

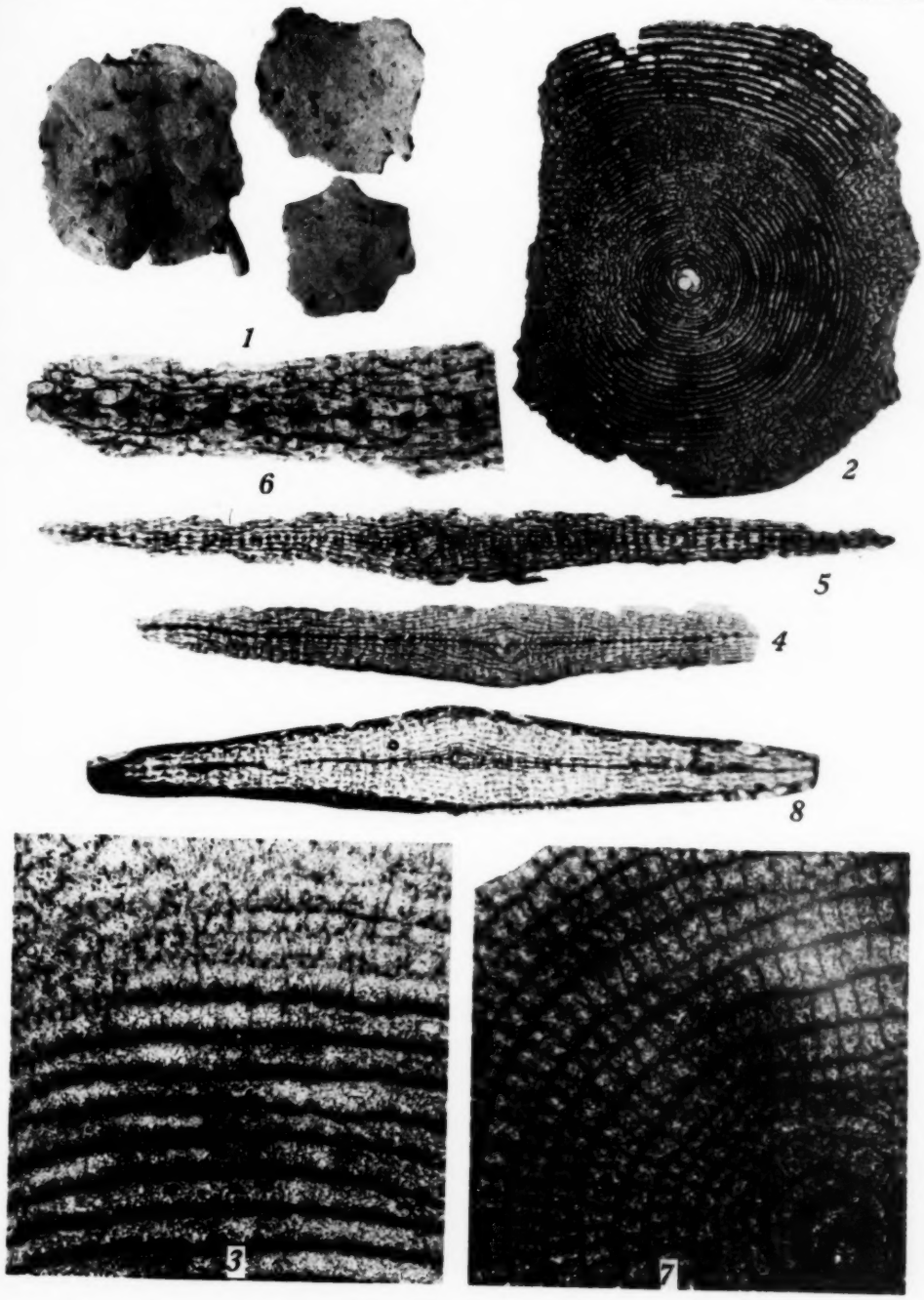
Test thin, undulate, flattish or selliform, surface minutely granulate. Diameter, 5 to 7 mm.; thickness through the center, 0.4 mm. in the specimen illustrated by Plate 42, fig. 4, which is about 4 mm. in diameter, or the diameter is about ten times the thickness in this specimen, but in other specimens the ratio is even greater.

The embryonic chambers are composed of an inner spherical chamber partly embraced by a curved outer chamber. The dimensions of the chambers are as follows:

EXPLANATION OF PLATE 42

FIGS. *1–6*—*Discocyclina cookei* Vaughan, n. sp. *1*, Views of the exterior of three specimens, ×5. *2*, Equatorial section, ×15. *3*, A part of the equatorial section, ×85, of the specimen represented by fig. *2*. This figure shows some of the radial walls, a few of which appear to reach from one annular wall to the next. Others are short. In most of the areas between annular walls the radial walls are absent. *4*, Vertical section of a specimen, ×27. *5*, Vertical section of another specimen, ×27. *6*, The peripheral part, ×85, of the left-hand of the specimen represented by fig. *5*. Note that the upper and lower walls of the equatorial layer almost touch, so that most of the equatorial layer is represented only by a dark line. (p. 256)

7, 8—*Discocyclina psila* Woodring. *7*, A part of the equatorial layer, ×85, of a specimen. The embryonic chambers are shown; it is also shown that the radial chamber walls of the equatorial layer are usually in alignment and that some of them are wavy, not entirely straight. The annular stolons of the equatorial chambers are on the distal sides of the chambers, but they are not clearly shown in the section. *8*, Vertical section of a specimen, ×27. (p. 256)



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Dimensions of Embryonic Chambers of Discocyclina cookei
(measurements include the walls)

Specimen number	(a) Diameter of smaller chamber	(b) Distance between ends of curved chamber	(c) Distance across both chambers at right angles to (b)
1	135μ	270μ	225μ
2	135	262	187

The thickness of the chamber walls is between 10 and 12μ. The embryonic chambers are definitely larger than in *D. blanpiedi*.

The equatorial chambers form 41 annuli in the specimen represented by Plate 42, fig. 2, in 2.27 mm., or the average distance between the middles of the walls of adjacent annuli is 55 μ. The range in the width of the annuli is from about 38 to about 76 μ. The annuli average wider than in *D. blanpiedi*. Radial chamber walls are absent, rudimentary, or indistinct. Along each annular wall there is a row of small granules, from which extend plate-like projections. The distance between the median lines of the granules ranges from 15 to 23 μ. Some of the plates extend half-way across the space between the annular walls; a few reach to or almost to the wall on the distal side of the chamber cavity and look like radial chamber-walls, the distance between such walls being about 15 μ. These plate-like projections may represent radial chamber-walls, which were very delicate and have been almost obliterated by secondary changes in fossilization. If this surmise should be correct, and apparently it is, the equatorial chambers are very narrow, with the radial diameter as much as four and a half times the transverse diameter. It could not certainly be made out whether the radial walls of adjacent annuli alternate in position or are aligned, but the latter appears to be the condition.

In a vertical section the equatorial layer is so depressed as to be almost obliterated. In the section illustrated by Plate 42, fig. 4, near the embryonic chambers it is represented by only a dark line; at the periphery of the more perfect side, about 1.9 mm. from the center, the height of the chamber cavity is about 30 μ. In another section (pl. 42, figs. 5, 6) of another specimen of about the same size, the relations are similar, the height of the cavity of a chamber at the periphery being 22 μ. The equatorial layer in *D. cookei* is more depressed than in *D. blanpiedi*. The roofs and floors are relatively thick, 30 to 37 μ. A few chambers near the periphery seem to show a pair of stoloniferous apertures similar to those in *D. pratti*, but is not certain.

The lateral chambers of *D. cookei* resemble those of *D. blanpiedi*. They appear in vertical section as narrow, elongate slits between the floors and roofs, and in general do not show definite arrangement in tiers. The thickness of the roofs and floors exceeds the height of the cavities. The number of layers over the center is not entirely definite because of imbrication. It is about eight or nine. The outer surfaces of the roofs bear granules similar to those in *D. blanpiedi* and there are a few weakly developed pillars.

Types.—Syntypes, two horizontal and two vertical sections; paratypes, three specimens mounted on cardboard; all from the foot of Salt Mountain, Clarke County, Alabama, out of a fresh road cut at the Jackson fault, deposited in the U. S. National Museum. Collected by C. W. Cooke.

Geologic horizon.—See introductory note.

Comparisons.—The differences between *D. cookei* and *D. blanpiedi* have been pointed out in the description of *D. cookei*. The test of *D. cookei* is larger than that of *D. blanpiedi*, it is usually undulate and may be selliform; the embryonic chambers of *D. cookei* are larger; the

annuli of the equatorial chambers are wider; the radial walls of the equatorial chambers are absent, rudimentary, or indistinct; the equatorial layer in vertical sections is so depressed that the roofs and floors almost touch and almost obliterate the chamber cavities, which are indistinct only near the periphery where their height is still less than that of the chambers in *D. blanpiedi*.

A question may properly be raised as to whether *D. cookei* should be referred to *Discocyclina*. Except that the radial walls of the equatorial chambers are so poorly developed, the essential structural features appear to be similar to those of *D. pratti* (Michelin), the genotype. Several species of *Discocyclina* have incompletely-developed, rudimentary, or obsolete radial walls in the equatorial chambers. Such is the condition in *D. floridana* (Cushman), *D. advena* (Cushman), and *D. stephensoni* Vaughan; and a similar condition is found in the specimens sent to me by Mr. Norton from the deep well in Washington County, Alabama. Apparently the structural features of the species now referred to *Discocyclina* require more detailed study than they have yet received. It is not unreasonable to surmise that the species now placed in *Discocyclina* may be distributed in two or more genera.

Douvillé may be correct in establishing for *Orthophragmina floridana* Cushman another genus, to which he has applied the name *Pseudophragmina* (Douvillé, H., 1923, p. 373). As a part of this discussion of species referred to *Discocyclina*, additional notes will be made on *Orthophragmina floridana* Cushman (Cushman, 1917, p. 116, pl. 40, fig. 3) = *Discocyclina floridana* (Cushman) Vaughan (Vaughan, 1928, p. 341, pl. 56, fig. 2) = *Pseudophragmina floridana* (Cushman) H. Douvillé (1923, p. 373, pl. 13, figs. 1–3). Because of the softness of the specimens it is very difficult, almost impracticable, to get satisfactory preparations for microscopic study. Several years ago, by impregnating specimens with bakelite, Mr. G. Leslie Whipple made at the Scripps Institution three horizontal and two vertical sections of topotype material from Marianna, Florida, and they are the basis of the following notes and accompanying illustrations.

The embryonic chambers are composed of an inner spherical chamber, about 113 μ in diameter, which is at one side of and surrounded by a larger chamber which is 300 μ in diameter. The thickness of the walls, because of the state of preservation, could not be accurately measured, but it appears to be about 15 μ. The embryonic chambers present the features usual in *Discocyclina*.

Douvillé (*op. sup. cit.*) has given a good description and good illustrations of the equatorial chambers. These chambers are radially elongate, the radial walls of adjacent annuli are in alignment, and usually they either do not reach the next outer annular wall or they are rep-

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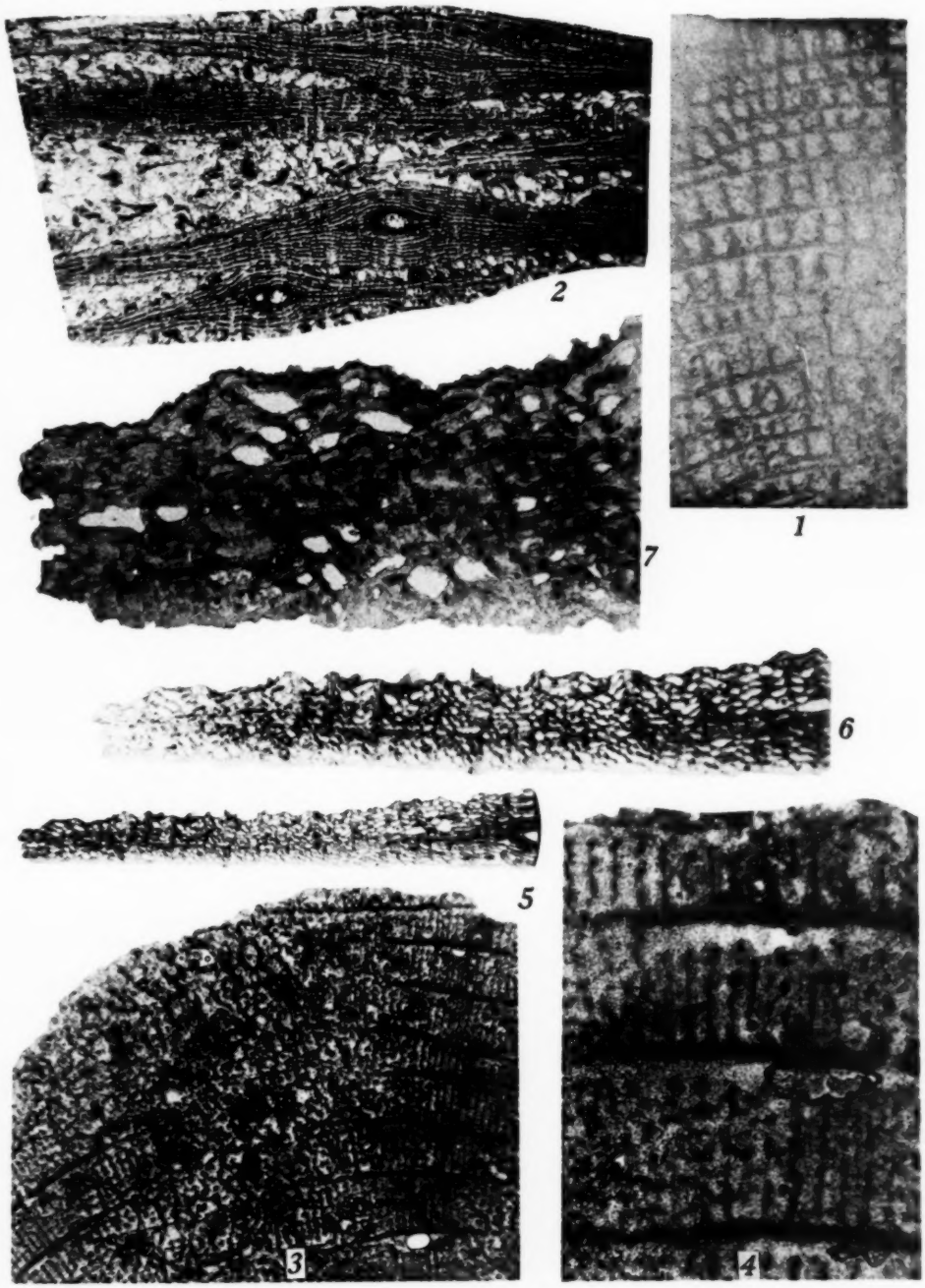
EXPLANATION OF PLATE 43

FIGS. *1*, *2*—*Discocyclina clarki* (Cushman) Vaughan, from Simi Valley, California. *1*, Equatorial chambers, ×85. The figure shows that the radial chamber walls are in alignment and that they do not meet the annular wall on the distal side of the chambers. *2*, Vertical section of several specimens, about ×28. (p. 256)

3–*7*—*Pseudophragmina floridana* (Cushman) Douvillé. *3*, Part of an equatorial section, ×27. *4*, A smaller part of an equatorial section, ×85. Figs. *3* and *4* show that the radial chamber walls are in alignment from one annulus to the next, that they are wavy and interrupted, and that many of them do not reach the annular wall on the distal side of the chambers. *5*, A vertical section, ×15, of one-half of a specimen. *6*, A part, ×27, of the vertical section of the specimen represented by fig. *5*. *7*, The peripheral part, ×85, of the specimen represented by figs. *5* and *6*. To the right of the two white spots near the left end of the figure, there are four small white dots in a horizontal row. These dots probably represent apertures for protoplasmic connection between chambers. (p. 258)



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resented in their distal portions by interrupted short plates or by granules. Furthermore, many of the chamber walls are wavy, not entirely straight (pl. 43, figs. 3, 4).

As seen in vertical section (pl. 43, figs. 5–7), the equatorial layer near the embryonic chambers is so depressed that it cannot be followed with certainty. Near the periphery the bounding walls and the chamber cavities are recognizable. In places near the periphery openings that simulate apertures for stolons are present, but the openings may be due to breakage or they may represent spaces between interrupted parts of chamber walls. These openings are single in a vertical section of a chamber, not paired, as in *D. pratti*.

Near the embryonic chambers the walls of the lateral chambers are thin and the spaces between them are very small, almost obliterated. Outside this zone, both vertically and horizontally, the cavities are vesicular, rather large, and their walls are distinct. Pillars are well developed. These features are better presented by the illustrations (pl. 43, figs. 5–7) than they can be in a description.

That *Discocyclina cookei* and *Pseudophragmina floridana* are different species is too obvious to require comment, but do they belong to the same genus? The embryonic chambers are similar in type, but the radial chamber walls are different and there are also differences in the lateral chambers. Unfortunately, important structural features cannot be made out with certainty on the preparations available. Notwithstanding this deficiency in information, the two species probably belong to different genera, and it will be reiterated that American species now placed in *Discocyclina* may, after more critical study, be placed in two or more different genera.

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REFERENCES

Cooke, C. Wythe, *1935*, Notes on the Vicksburg group: *Am. Assoc. Petroleum Geologists, Bull.* vol. 19, no. 8, pp. 1162–1172.

Cushman, J. A., *1917*, Foraminifera of the genus *Orthophragmina* from Georgia and Florida: *U. S. Geol. Survey, Prof. Paper* 108-G, pp. 115–124, pls. 40–44.

Douvillé, H., *1923*, Les Orbitoïdes et leur évolution en Amérique: *Soc. géol. France, Bull.*, 4th sér., tome 23, pp. 369–376, pl. 14.

Schenck, Hubert G., *1929*, *Discocyclina* in California: *San Diego Soc. Nat. Hist., Trans.*, vol. 5, no. 14, pp. 211–240, pls. 27–30, figs. 1–10.

Vaughan, T. Wayland, *1900*, The Eocene and lower Oligocene coral faunas of the United States with descriptions of a few doubtfully Cretaceous species: *U. S. Geol. Survey, Mon.*, vol. 39, pp. 263, 24 pls.

——— *1919*, Fossil corals from Central America, Cuba, and Porto Rico, with an account of the American Tertiary, Pleistocene, and Recent coral reefs: *U. S. Nat. Mus., Bull.* 103, pp. 189–524, pls. 68–152.

——— *1928*, Family 45. Orbitoididae, in Cushman, J. A., *Foraminifera, their classification and economic use*, pp. 335–356, pls. 56–59.

——— *1929*, Descriptions of new species of the genus *Discocyclina* from the Eocene of Mexico: *U. S. Nat. Mus., Proc.*, vol. 76, art. 3, pp. 1–18, pls. 1–7.

Woodring, W. P., *1930*, Upper Eocene orbitoid foraminifera from the western Santa Ynez Range, California, and their stratigraphic significance: *San Diego Soc. Nat. Hist., Trans.*, vol. 6, no. 4, pp. 145–170, pls. 13–17.

——— *1931*, Age of the orbitoid-bearing Eocene limestone and *Turritella variata* zone of the western Santa Ynez Range, California: *San Diego Soc. Nat. Hist., Trans.*, vol. 6, no. 25, pp. 371–388.

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BLASTOIDS OF THE OSAGE GROUP, MISSISSIPPIAN: PART I. THE GENUS *SCHIZOBLASTUS*

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ABSTRACT

The genera *Schizoblastus* and *Cryptoblastus* are compared and contrasted, and an emended diagnosis is offered for *Schizoblastus*. Considerable new information is presented concerning *Schizoblastus*, and a new subgenus, *Monoschizoblastus*, is proposed. Nine species and varieties of *Schizoblastus* are described and illustrated; six of them are described for the first time. A discussion of the geographic and stratigraphic occurrence of *Schizoblastus* is also given.

In North America the Osage strata of the Mississippi Valley province are unusually rich in echinoderm remains, of which blastoids comprise no inconsiderable portion. Quarries in the Burlington limestone at Burlington, Iowa, and at Hannibal and Louisiana, Missouri, have in the past yielded large numbers of blastoids, and more recently blastoids have been obtained in considerable numbers at Sedalia and at Springfield, Missouri. Partly because of the accessibility of these outcrops, large numbers of blastoids have annually been added to the collection at the State University of Iowa, and it has reached considerable proportions. About 1909, through the generosity of Frank Springer, the repository at the State University of Iowa came into possession of duplicate material of the Springer echinoderm collection, the main portion of which has been deposited in the United States National Museum.

A survey of the blastoids in the State University of Iowa collection indicated that many of the species were incorrectly identified, and a review of the literature on blastoids has revealed a need for research on the Osage species. Accordingly, I have undertaken such a study. Special attention has been directed to the geographic and geologic occurrences in the hope that they would furnish some much-needed stratigraphic information. It has been demonstrated that most crinoids have a limited vertical range and for this reason they are excellent guide fossils in local areas, although limited horizontal distribution usually prevents their use for widespread correlations. Blastoids should prove to be as useful for correlation purposes as the crinoids because of their similar habits, and indeed most of the Osage species seem to have a very limited vertical range.

In addition to studying the material in the Iowa collection I have spent considerable time in the field in Iowa and Missouri collecting blastoids, and Dr. L. R. Laudon of the University of Tulsa, who has spent portions of several field seasons collecting in the Burlington area, has loaned his entire collection to me for

study. The Laudon collection has proved especially valuable from a stratigraphic standpoint because the specimens have been very carefully collected and labeled.

No claims to completeness in this study of *Schizoblastus* and *Cryptoblastus* are made, for these genera cannot be thoroughly diagnosed until the Springer collection in the United States Museum has been studied. Also, the exact status of many species will of necessity remain in doubt until types in the R. R. Rowley collection, not now available for study, have been restudied. Another difficulty is that many type specimens have been lost. Some of Swallow's types presumably were lost in the fire at the University of Missouri in 1892. Professor Werner of Washington University has recently written me that none of Hambach's types are now at Washington University, and that Hambach had sold many of his fossils.

The Osage group comprises the lower middle part of the Mississippian system, and in the Mississippi Valley is classified as follows:

Series	*Group*	*Formation*
Valmeyer	Osage	Warsaw
		Keokuk
		Burlington
		Fern Glen (in part St. Joe, Reeds Spring, Sedalia).

In the present paper we are concerned primarily with the zones of the Burlington limestone, since most of the species here described came from zones within that formation.

Niles and Wachsmuth (1886) proposed on the basis of crinoid remains to divide the Burlington limestone (as delineated by Hall in 1858) into two members, the lower Burlington and the upper Burlington. This was not the first attempt to divide the Burlington, for C. A. White (1860) had earlier divided the rocks exposed at Burlington, Iowa, into eight beds; but the work by Niles and Wachsmuth was the first attempt to divide the Burlington into zones by means of crinoids. Subsequent studies have extended the known vertical range of many of the Burlington crinoids, and although lower and upper divisions of the formation are still recognized, it is now generally conceded that neither lithologic nor faunal evidence, nor both, warrants a division of the Burlington limestone into members. However, it is possible to recognize definite faunal zones within the formation. Keyes and Rowley (1897) separated the lower part of the Burlington limestone at Louisiana, Mo., into five zones upon lithologic and faunal grounds, and the upper portion of the formation which is represented at Louisiana they divided into three zones. Later, Rowley (1900) discussed the vertical range of each of the twenty species of blastoids at that time known to occur in the Burlington formation at Louisiana. A few years later Rowley (1908) recognized only four zones in the "Lower Burlington" at Louisiana, and he stated that "there is no persistency in the character of the Upper Burlington and it is almost impossible to separate into divisions." Van Tuyl (1925) has written concerning the stratigraphy of the Osage group

in Iowa and has described the formations bed by bed and listed the fossils at that time known to occur in each bed. Moore (1928) has done essentially the same thing for the Kinderhookian series and the Osage group in Missouri. L. R. Laudon (1929) has recently done some excellent stratigraphic work on the Burlington limestone of Louisa and Des Moines counties, Iowa, although all of the results of his investigation have not yet been published. Laudon recognizes six faunal zones within the Burlington as follows:

Upper Burlington	*Dorycrinus cornigerus* zone
	Pentremites elongatus zone
	Dizygocrinus rotundus zone
	Hadrophyllum glans zone
Lower Burlington	*Macrocrinus konincki* zone
	Physetocrinus ventricosus zone

These zones are proving to be of value for correlation purposes over a considerable area. The *Dizygocrinus rotundus* fauna has been identified by Cline (1934, p. 1146) as far away as Springfield in southwestern Missouri, and the *Pentremites elongatus* fauna seems to be recognizable as far southwest as Spavinaw in northeastern Oklahoma.

It has been almost fifty years since Etheridge and Carpenter (1886) published their monographic work on blastoids, and until a comparatively recent date little information that is new has been contributed to our knowledge of blastoid morphology. One of the most startling finds that has been recorded in the field of blastoid study since 1886 was made known with the announcement by Bather (1908) of the occurrence of the genus *Schizoblastus* on the island of Timor in the Dutch East Indies. Bather believed that the containing strata were Lower Carboniferous in age, but they have since been shown to be Middle Permian. This makes the find all the more remarkable when one recalls that the genus *Schizoblastus* is known only from the Mississippian of North America, the Lower Carboniferous of Ireland (the two species which Etheridge and Carpenter have described from Ireland are here referred to a new subgenus, *Monoschizoblastus*), and the Middle Permian strata of Timor, not even one species of the genus having been described from the intervening Pennsylvanian system.

Recently Wanner has publlshed several papers on the Permian biastoids of Timor and his very thorough studies mark the first real progress that has been made in the field of blastoid morphology since the time of Etheridge and Carpenter. In addition to describing several new genera and species, Wanner has made some observations on *Schizoblastus* which have proved to be particularly significant, and certain of his suggestions have been of great help in my studies.

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SYSTEMATIC DESCRIPTIONS

Genus SCHIZOBLASTUS Etheridge and Carpenter, 1882

Etheridge and Carpenter (1882, p. 243) recognized that *Granatocrinus* Hall (=*Orbitremites* Austin and Austin), to which a rapidly increasing number of species was being assigned, included some widely different forms. Accordingly they redefined *Granatocrinus* and established the genus *Schizoblastus* for blastoids resembling *Granatocrinus* in gross form but differing in other respects. They designated *Pentremites sayi* Shumard as the genotype of *Schizoblastus*. Their concept of *Schizoblastus* was much broader at first than as indicated in their "Catalogue of the Blastoidea," published in 1886. In this later work two of the species which originally were regarded as belonging to *Schizoblastus* were referred to a new genus, *Cryptoblastus*, one of them (*Pentremites melo* Owen and Shumard) being taken as the type of that genus; two others were referred to two new genera, *Mesoblastus* and *Heteroblastus*.

When Etheridge and Carpenter (1886, pp. 220–224) emended *Schizoblastus*, their revised generic diagnosis was based on characters shown by *Pentremites sayi* Shumard (the genotype), *Schizoblastus bailyi* Etheridge and Carpenter, *Granatocrinus melonoides* Meek and Worthen, and *Granatocrinus rofei* Etheridge and Carpenter. Eight other species were questionably referred to *Schizoblastus* but apparently were not used in formulating the generic diagnosis.

Since 1886 other species have been assigned to *Schizoblastus* but the generic diagnosis remained essentially unaltered until it was emended by Wanner (1924) who notes that in most of the schizoblastids from the island of Timor the hydrospire tubes terminate distally approximately at the height of the radio-deltoid suture. Wanner gives a text figure (fig. 8, p. 41) to show how the ambulacra border the body cavity above this suture and how below the suture they rest in grooves in the radials. He also states that the most noteworthy characteristic in which the Permian schizoblastids of Timor differ from their older representatives is in the presence of a suture transverse to the anus dividing the posterior deltoid into two plates, the *epideltoid* and the *hypodeltoid*. Wanner noted the possibility that this suture had been overlooked in the Carboniferous species, or if it had been seen, that it had been mistaken for a crack, as he had done in the first Timor specimens studied. Acting upon this suggestion, I began to study the American representatives of *Schizoblastus* to determine whether such a suture existed. I have discovered that it is present in *S. sayi*, the genotype, and in all of the other Osage representatives of the genus that I have had the opportunity to study, which includes all except one or two doubtful species.

Another of Wanner's observations on *Schizoblastus* which has proved to be especially significant is that all of the Permian species have four hydrospire folds beneath each ambulacrum, or two to each side, whereas the Carboniferous species of the genus (as it was at that time conceived to be) have either one to a side or four to a side.

In a collection of American Carboniferous blastoids which Wachsmuth had loaned Etheridge and Carpenter for study, there were several specimens which these authors identified as *Pentremites sayi* Shumard. In their original description of *Schizoblastus* (1882, p. 286) and also in the emended description of the genus (1886, pp. 220, 221) these authors state that *S. sayi* has four hydrospire folds on each side of the ambulacrum, but in their illustration they show *five* hydrospire folds on each side of the ambulacrum, making a total of ten for each ambulacrum; the legend for this figure (their pl. 17, fig. 1) reads: "Cross section of an ambulacral field and hydrospires attached, five tubes on each

side; the lancet plate is trebly perforated."

In my collection there are representatives of *S. sayi* (Shumard) from at least six different localities in Missouri and Iowa (including two lots from Burlington, Iowa, the locality where Wachsmuth collected the specimens which he sent Etheridge and Carpenter for study), and I have polished sections and thin-sections of specimens which represent many variations but in every instance there are only two hydrospire sacs on each side of the ambulacrum (see pl. 44, fig. 11, this paper) and not four as Etheridge and Carpenter state. My specimens were ground and observed at brief, regular intervals, but in none of the sections in any of the specimens were there more than two hydrospire folds on each side of an ambulacrum. Thus, I am convinced that in choosing a specimen to section, Etheridge and Carpenter were unfortunate enough to choose an aberrant form, one not in the least representative of *S. sayi*. Possibly in choosing this specimen they selected a poorly-preserved one rather than mutilate a better specimen, for they did not have a large number of specimens from which to choose—Bather (1899) lists only twelve specimens in the collection of the British Museum. Additional evidence that the specimen illustrated by Etheridge and Carpenter is not *S. sayi* is seen in its possession of three longitudinal canals in the lancet-plate, whereas in every specimen of *S. sayi* which I have seen there is only one such canal and it is subcentral in position (see pl. 44, figs. 7–12, this paper). It is thus reasonable to conclude not only that their specimen is not *S. sayi* (Shumard), but that it may belong to a different genus.

Granatocrinus rofei Etheridge and Carpenter, 1882, [*Schizoblastus rofei* (Etheridge and Carpenter), 1886] has many of the characteristics of *S. sayi* var. *sayi*, the genotype, but it has only one hydrospire fold beneath each ambulacrum and there may be a difference in the posterior deltoid plate, i.e., it may not be divided into epi- and hypodeltoid plates by a suture crossing the anus; from the description and figures given by the nomenclators it is not possible to tell whether this division exists, but in view of the fact that these writers overlooked this suture in *S. sayi*, it is also possible that such a suture is present in *S. rofei* and has also been overlooked.

Hydrospires are peculiar to the class Blastoidea and have received considerable attention in recent schemes of classification. Etheridge and Carpenter did not attach as much importance to the number of folds as I am inclined to do. Hambach (1903, p. 18) did not even regard them as being of specific importance, stating that the number often differs in one individual. I have sectioned a large number of specimens of several different genera and have yet to find a single specimen in which the number of hydrospire folds varies within a species. Of course, such a thing is possible because occasionally one meets with an aberrant specimen—a number of cases have been reported in which one of the rays has been aborted, and even six-rayed blastoids have been observed—in view of these abnormalities it is conceivably possible that in some few individuals the number of hydrospire folds may vary. If the hydrospire folds represent the respiratory apparatus of the blastoid, as is now generally believed, they should be a fairly safe criterion on which to base a classification. Brachiopods, like cephalopods, are classified partly on branchial supports, and this classification has proven satisfactory. In any event, the hydrospires are located beneath the ambulacra and are thus somewhat protected so that they should not respond readily to minor changes in environment and, therefore, they should at least be constant within a species. The internally located siphuncle of nautiloid and ammonoid cephalopods changed slowly, although the test responded readily to environmental changes. My own observations indicate that in the families Nucleocrinidae and Orbitremitidae the

number of hydrospire folds is constant for each genus, and, if this is true generally, as I believe it is, then *Schizoblastus rofei* (Etheridge and Carpenter) should be removed from *Schizoblastus*. The fact that the posterior spiracles are fused with the anus (they are separated in the genotype of *Schizoblastus*) and the possible difference in the structure of the posterior deltoid also suggest that this species should be removed from *Schizoblastus*. Accordingly, I hereby designate *Granatocrinus rofei* Etheridge and Carpenter, 1882 [=*Schizoblastus rofei* (Etheridge and Carpenter), 1886] as the type of a new subgenus which I propose to call *Monoschizoblastus*, to call attention to the fact that there is only one hydrospire fold on each side of an ambulacrum. It is not to be supposed, however, that this feature is present in this genus alone, for *Orbitremites* has the same number of hydrospires. *Schizoblastus bailyi* Etheridge and Carpenter also has the posterior spiracles confluent with the anus and although its hydrospires are unknown, it probably should be referred to *Monoschizoblastus* because it came from the same formation and locality as *Monoschizoblastus rofei* (i.e., from the Lower Carboniferous limestone of Ireland).

Careful sectioning has revealed that the hydrospire folds in *Schizoblastus* represent an upward and inward extension of the radials (see pl. 44, figs. 6–12). In all of the American species of *Schizoblastus* which I have examined, except *S. etheridgei*, the lower ends of the deltoids rest on and overlap the beveled upper edges of the radials, and from Wanner's illustrations it appears that this is also generally true for the Timor representatives of the genus. A series of polished sections show that the hydrospire folds first appear as infolds of the radials. Just above the lower extremities of the ambulacra there is a single fold on each side of the ambulacrum, the outer wall of the fold is attached to the inner wall of a radial limb, and its substance is continuous with that of the radial. The inner wall of the fold is continuous with the inner wall of the fold on the other side of the ambulacrum, and the two form a support for the lancet for a short distance upward. In a higher section the single fold on each side of the ambulacrum bifurcates on the inside, giving rise to two folds instead of one. The inner wall, which was common to the two folds, has now divided but the upper edges of these inner walls still support the mid-portion of the lancet and this relationship continues upward throughout most of the length of that plate. A section cut a little above the radio-deltoid suture shows that the radial plates have begun to thin upward and that the deltoids have begun to take their place. A section a little above this last one shows the remnants of the radials at the border of the sinus, and in a yet higher section all that remains of the radials is the outer walls of the hydrospire folds which end upward against the outer and inner edges of the deltoids. I first discovered this suture while studying a thin-section under plane polarized light, for I noticed that the optical orientation of the calcite composing the outer walls of the hydrospire folds was not the same as that in the walls of the deltoid. Further investigation in sections cut below the radio-deltoid suture revealed that the orientation of the calcite in the hydrospire folds was the same as that of the adjacent radials.

DIAGNOSIS OF *Schizoblastus*

The following emended generic diagnosis is proposed for *Schizoblastus:* Calyx subglobose, ovoid, elliptical, or melon-shaped; summit contracted; base typically concave, but in a few cases flat or even slightly protuberant. Basalia and bodies of radials generally forming part of the basal concavity and, therefore, invisible laterally, but exceptionally visible from the side. Radials typically shorter than deltoids, reaching less than one-half height of calyx, but occasionally extremely long and deltoids then corre-

spondingly short; upper edges of radials commonly beveled, lower edges of deltoids resting on and overlapping this beveled surface; posterior deltoid in all cases divided into epideltoid and hypodeltoid plates by a suture transverse to the anus. Adoral portion of hypodeltoid produced into a hoodlike process of variable size, generally large enough to be quite prominent. Ambulacra reaching almost height of calyx and commonly rather narrow, except for some of the Timor species. Median portion of lancet exposed, but exposed portion decreases in width aborally. Side-plates 20 to 90 to a row, resting in shallow depressions on lateral slopes of lancet; outer side-plates present. No hydrospire-plate. Hydrospire pores present at borders of sinus throughout length of ambulacrum. Two hydrospire folds on each side of ambulacrum (or four beneath each ambulacrum); the folds are attached to and supported by, and their substance is continuous with, the radials; the upper edges of the inner walls of the hydrospires support the lancet-plate; the upper edges of the outer walls terminate against the inner walls of the deltoids at the sinus border. Ten small slit-like spiracles excavated in lateral edges of apices of deltoids and closed on ambulacral side by lancet-plate and uppermost side-plates; posterior spiracles separated from anus. Peristome covered by an integument of numerous irregular plates of the more or less firmly knit "Oralhut" of Wanner.

In certain instances it has been difficult to determine whether a species should be referred to *Schizoblastus* or to *Cryptoblastus*, which differs from *Schizoblastus* in having a hydrospire-plate separating the lancet-plate from the wall of the radial sinus but not extending above the radio-deltoid suture, so that hydrospire pores do not occur above this level. It also differs in having the posterior pair of spiracles confluent with the anus, and as a general rule the deltoids are very short.

Distribution of Schizoblastus.—*Schizoblastus* was formerly listed as occurring in the Kinderhookian and Valmeyerian series of the Mississippian system of North America, the Lower Carboniferous of Ireland, and the Middle Permian Basleo beds of Timor.

According to Peck (1929) *Schizoblastus* does not occur in the Chouteau limestone (upper Kinderhookian) of Missouri, as was formerly supposed. The two Irish species which have heretofore been referred to *Schizoblastus* are here referred to *Monoschizoblastus*.

Thus, all of the species that I can definitely refer to *Schizoblastus* are those that occur in the Middle Mississippian (Valmeyerian series) of North America and those from the Middle Permian of Timor.

In North America the genus seems to be confined to strata of Osage age. It is rare in the Reeds Spring formation of southwestern Missouri and in the lower part of the Burlington formation in Iowa, and it is abundant in the upper part of the Burlington in Iowa and Missouri. From the existing description and illustrations it is not possible to tell whether or not *Granatocrinus lotoblastus* White of the Lower Carboniferous of Arizona and Wyoming belongs in the genus *Schizoblastus*. According to Peck (1929) *Schizoblastus haynesi* Clark of the Madison limestone of Montana may be the same as *Pentremites roemeri* Shumard, and Peck states that the latter species probably represents *Cryptoblastus*.

SCHIZOBLASTUS SAYI (Shumard) *sensu lato*

Pentremites sayi SHUMARD, B. F., *1855*, in G. C. Swallow's "First and second annual reports of the Geol. Survey of Missouri," pt. 2, pp. 185, 186, pl. B, figs. 1*a–d*.—HAMBACH, *1880*, St. Louis Acad. Sci., Trans., vol. 4, pp. 148, 153, 156; *1884*, St. Louis Acad. Sci., Trans., vol. 4, pp. 540, 545, 546.—GREGOR, *1934*, St. Louis Acad. Sci., Trans., vol. 28, p. 171.

Granatocinus sayi SHUMARD, *1866*, St. Louis Acad. Sci., Trans., vol. 2, p. 376.—MEEK and WORTHEN, *1869*, Acad. Nat. Sci. Philadelphia, Proc., p. 84.—WACHSMUTH and SPRINGER, *1881*, Acad. Nat. Sci. Philadelphia, Proc., pl. 19, fig. 3.—GREGOR, *1934*, St. Louis Acad Sci., Trans., vol. 28, p. 137.

Pentremites potteri HAMBACH, *1880*, St. Louis Acad. Sci., Trans., vol. 4, pp. 156, 157, pl. B, fig. 4.—GREGOR, *1934*, St. Louis Acad. Sci., Trans., vol. 28, p. 166.

Schizoblastus sayi ETHERIDGE and CARPENTER, *1882*, Annals and Mag. Nat. Hist., 5th. ser., vol. 9, p. 246; *1886*, Catalogue of the Blastoidea, pp. 221–226, pl. 3, figs. 1–3; pl. 6, fig. 18; pl. 10, fig. 17 [but not pl. 17, fig. 1].—KEYES, *1894*, Missouri Geol. Survey, vol. 4, pt. 1, p. 138, pl. 18, figs. 9*a b*.—KEYES and ROWLEY, *1897*, Iowa Acad. Sci., Proc., vol. 4, p. 32.—WELLER, *1898*, U. S. Geol. Survey, Bull. 153, p. 551.—BATHER, *1899*, The species of Blastoidea, p. 65.—ROWLEY, *1900*, Am. Geologist, vol. 26, p. 247; *1901*, Am. Geologist, vol. 27, pl. 28, figs. 15, 16, 28; *1904*, in G. K. Greene's "Contribution to Indiana paleontology," pt. 19, p. 196; *1905*, Am. Geologist, vol. 35, p. 302, pl. 21, fig. 4; *1908*, Missouri Bur. Geol. and Mines, 2d. ser., vol. 8, p. 40.—BATHER, *1908*, in G. Boehm's "Geologische Mitteilungen aus dem Indo-Australischen Archipel.," Neues Jahrb., Beilage-Band 25, pp. 317, 318.—GREGOR, *1934*, St. Louis Acad. Sci., Trans., vol. 28, p. 179.

Schizoblastus (*Granatocrinus*) *sayi* WACHSMUTH, *1883*, Illinois Geol. Survey, vol. 7, pt. 2, p. 350; *1886*, Davenport Acad. Nat. Sci., Proc., vol. 4, p. 80.—WACHSMUTH and SPRINGER, *1887*, Acad. Nat. Sci. Philadelphia, Proc., pp. 3, 4, 15.

Schizoblastus potteri ETHERIDGE and CARPENTER, *1886*, Catalogue of the Blastoidea, footnote p. 223, and p. 226.—WELLER, *1898*, U. S. Geol. Survey, Bull. 153, p. 551.—ROWLEY, *1904*, in G. K. Greene's "Contribution to Indiana paleontology," pt. 19, p. 196.—BATHER, *1908*, in G. Boehm's "Geologische Mitteilungen aus dem Indo-Australischen Archipel.," Neues Jahrb., Beilage-Band 25, pp. 317, 318.—CLARK, *1917*, Harvard Coll. Mus. Comp. Zoology, Bull., vol. 61, no. 9, p. 373.

Cribroblastus potteri HAMBACH, *1903*, St. Louis Acad. Sci., Trans., vol. 13, pp. 41, 42, pl. 5, fig. 15.—GREGER, *1934*, St. Louis Acad. Sci., Trans., vol. 28, p. 130.

Cribroblastus sayi HAMBACH, *1903*, St. Louis Acad. Sci., Trans., vol. 13, p. 42, pl. 5, fig. 14.—GREGER, *1934*, St. Louis Acad. Sci., Trans., vol. 28, p. 131.

Cribroblastus verrucosus HAMBACH, *1903*, St. Louis Acad. Sci., Trans., vol. 13, pp. 58, 59, pl. 5, fig. 3.—ROWLEY, *1904*, in G. K. Greene's "Contribution to Indiana paleontology," pt. 19, p. 196.—GREGER, *1934*, St. Louis Acad. Sci., Trans., vol. 28, p. 131.

Schizoblastus? verrucosus BATHER, *1908*, in G. Boehm's "Geologische Mitteilungen aus dem Indo-Australischen Archipel.," Neues Jahrb., Beilage-Band 25, p. 318.

When Etheridge and Carpenter (1882, p. 243) established *Schizoblastus* they selected *Pentremites sayi* Shumard of the "Encrinital Limestone" (Burlington) of Missouri as genotype. Since the founding of this genus, many faunal charts have recorded the presence of *S. sayi* in formations of lower and middle Osage age in the central United States. Some of the horizons and localities from which it has been identified are as follows: throughout the Burlington limestone of southeastern Iowa; from the Sedalia and Burlington limestones of northeastern Missouri; from the Burlington limestone of east-central Missouri; from the Reeds Spring and Burlington limestones of southwestern Missouri; and from the St. Joe formation of northeastern Oklahoma. Such a wide geographical and stratigraphical range as that indicated is unusual for stalked echinoderms. Because of their limited vertical range, and to a less extent their horizontal range, most species of pelmatozoans are generally believed to serve as excellent stratigraphic markers within a limited area. This unusually wide range of *S. sayi* attracted my attention several years ago and a study of several fossil collections from Osage strata of the southern Ozarks revealed wide variation in size and shape in some of the blastoids which had been identified as *S. sayi*. In 1934, I (Cline, 1934, pp. 1140, 1144) indirectly called attention to this variation in shape by identifying four blastoids from the type section of the Reeds Spring formation as *Schizoblastus sayi* (Shumard) *sensu lato*.

In the collection that I am now studying there are 59 specimens labeled as *Schizoblastus sayi*, representing collections by four different paleontologists. Of the 59 specimens only 5 are strictly conspecific with Shumard's original figures (1855) of *Pentremites sayi*. Of the remaining specimens, 38 belong to varieties of *S. sayi* and the others to different species. At least five distinct varieties of *S. sayi* should be recognized. Most specimens of *S. sayi* can readily be classified as belonging to one or another of the varieties, but rarely a specimen is en-

countered which seems to occupy an intermediate position between some of them and then classification is difficult. The view that I am here adopting may be severely criticized by some paleontologists, but if we are to continue to make headway in stratigraphic paleontology, our concept of a species must of necessity be narrower than that of most paleontologists of a few decades ago, for we must "split" some of the more unwieldy species, like *S. sayi*, into several different species, or at least recognize more than one variety of a given species. In the case of *S. sayi* it seems better to take the more conservative course and recognize varieties rather than species, in view of the fact that some of the varieties apparently grade into others. In a small fossil collection the possibility of encountering intermediate or transitional forms is not great, and it is then easier to recognize different species, but the more extensive the collection the more difficult it becomes to classify certain specimens.

In their revised discussion of *S. sayi*, Etheridge and Carpenter (1886, p. 224) state that the calyx is "subglobose or occasionally somewhat ovoidal" and that the base is "flattish, sometimes a little concave, or slightly protuberant"; yet Shumard's original figures of the type, and Hambach's (1903, pl. 5, fig. 14) later illustration of it, show a form distinctly wider than high and with a base so con-

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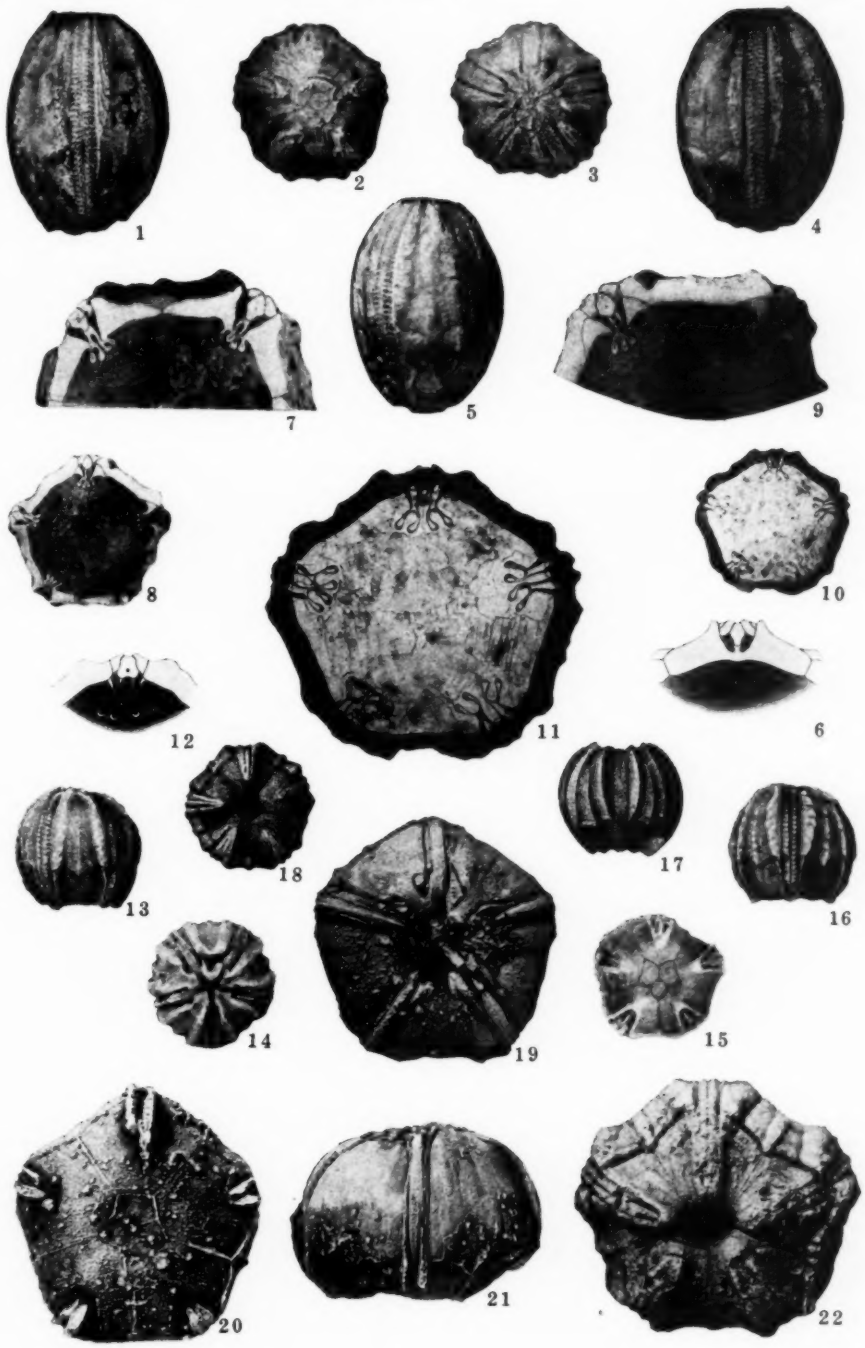
EXPLANATION OF PLATE 44

FIGS. *1–5*—*Schizoblastus laudoni* Cline, n. sp. The holotype and only known representative of the species; from the lower part of the Burlington limestone of southeastern Iowa. *1*, Left antero-ambulacral view; *2*, *3*, basal and summit views; *4*, *5*, right antero-ambulacral and right antero-interambulacral views. All ×2. (p. 277)

6–16—*Schizoblastus sayi* (Shumard) var. *obesus* Cline, n. var., from the upper part of the lower division of the Burlington limestone of Missouri. *6–12*, A series of sections from the distal ends of the ambulacra to the height of the periphery showing the development of the hydrospire apparatus. *6*, Diagrammatic transverse section (×4) just below the lowest (aboralmost) position on the radio-deltoid suture; at this height the deltoid plates have just begun to overlap the radials and the hydrospires are in the process of formation, although the tubes are not yet folded; note the elevated process (part of the radial plate) which supports the lancet-plate. *7*, Retouched photograph (×4) of a polished section transverse to the calyx just above the radio-deltoid suture, showing how the deltoids have completely overlapped the radials, although the walls of the body cavity are still formed by the radials; four hydrospire folds have formed beneath each ambulacrum although they are not completely developed; from this photograph it is clear that the hydrospire folds are developed as crenulations of the inner walls of the radials and that the lancet-plate is supported by the upper edges of the inner walls of the hydrospire folds; the lancet-plate is perforated by a small subcentral canal. *8*, Retouched photograph (×2) of a polished section just below the periphery. *9*, An enlarged portion of fig. 8; note that all that remains of the radials is the thickened upper ends of the outer walls of the hydrospire folds. *10*, *11*, Unretouched photograph (×2) of a thin-section at the periphery photographed by transmitted light and the same section enlarged to four diameters and slightly retouched. *12*, Diagrammatic section (×4) just above the periphery showing the upper edges of the outer walls of the hydrospire folds terminating against the inner walls of the deltoids and the inner walls of the hydrospires supporting the lancet; the hydrospires represent all that remains of the radials; section drawn from a photograph, so the proportions are accurate. *13–16*, Postero-interambulacral, summit, basal, and left postero-ambulacral views (×2) of two paratypes; the specimen represented by fig. 15 is fragmentary, the summit being broken; figs. 14 and 15 are unretouched photographs. (p. 272)

17–22—*Schizoblastus sayi* (Shumard) var. *sayi* Cline, n. var. *17*, *18*, Lateral and basal views (×1) of the holotype (reproductions of Shumard's original illustrations). *19–21*, Summit, basal, and left antero-interambulacral views (×2) of an internal mold from the upper part of the Burlington limestone of northeastern Missouri. *22*, Basal view (×2) of another specimen preserving the test; figs. 19, 20, and 22 are unretouched photographs. (p. 269)



Cline, Lower Mississippian Blastoids

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cave that the calyx rests on a quinquepod composed of the lower extremities of the ambulacra. In fairness to Etheridge and Carpenter it should be mentioned that in Shumard's description there are conflicting statements regarding the relative proportions of the radials and the deltoids, and the dimensions that he lists do not check accurately with corresponding measurements of his figures. Apparently Shumard based his description on more than one specimen, there was some variation in the height-to-width ratio, and the relative proportions of radial and deltoid plates were not the same in all specimens. Concluding that the figures are accurate, I here designate the form figured by Shumard (see pl. 44, figs. 17, 18, this paper) as the type of *Schizoblastus sayi* var. *sayi*, and this variety automatically becomes the type of the genus.

SCHIZOBLASTUS SAYI (Shumard) var. SAYI
Cline, n. var.[1]

Plate 44, figures 17–22

Pentremites sayi SHUMARD, *1855*, in G. C. Swallow's "First and second annual reports of the Geol. Survey of Missouri," pt. 2, pp. 185, 186, pl. B, figs. 1*a–d*.—HAMBACH, *1884*, St. Louis Acad. Sci., Trans., vol. 4, p. 545.

Granatocrinus sayi SHUMARD, *1866*, St. Louis Acad. Sci., Trans., vol. 2, p. 376.

Schizoblastus sayi ETHERIDGE and CARPENTER, *1882*, Annals and Mag. Nat. Hist., 5th ser., vol. 9, p. 246; *1886*, (part) *Catalogue of the Blastoidea*, pp. 224–226.

Cribroblastus sayi HAMBACH, *1903*, St. Louis Acad. Sci., Trans., vol. 13, pl. 5, fig. 3.

The form represented by figures *1a-d* in Shumard's (1855) description of *Pentremites sayi* I propose to call *Schizoblastus sayi* var. *sayi* to distinguish it from several other related but distinct forms which have collectively been referred to as *S. sayi* (Shumard).

The following description is based partly on Shumard's original description and figures of *Pentremites sayi*, partly on the discussion of *Schizoblastus sayi* (Shumard) by Etheridge and Carpenter (1886, pp. 224–226, pl. 3, figs. 1–3; pl. 6, fig. 18; pl. 10., fig. 17; but not pl. 17, fig. 1) but largely on five specimens in my collection.

Description.—Calyx large, subglobose, wider than high; measurements of Shumard's figured specimen are: width 20 mm., height 16.5 mm.; my specimens average about 19.7 mm. wide and 16.5 mm. high. In lateral view calyx rounded in outline except for truncated adoral and aboral ends; transverse section at periphery almost circular but becoming distinctly pentagonal aborally. Periphery equatorial. Summit flat or slightly concave; contracted. Base small, contracted, decidedly concave, the calyx resting entirely on a quinquepod formed by protruding lips of radials.

Stem-facet small, circular. Basals small, forming a concave cup, and invisible laterally. Azygous basal small and quadrate; paired basals larger and pentagonal, giving base a crude pentagonal outline.

Radials small, comprising almost exactly one-fourth length of calyx measured around the outside; comprising most of the field in a basal view, but invisible orally; slightly wider than high, width expanding upward; bases of two radials flat, the others broadly angular and resting in retreating angles of basalia; bodies very short; limbs relatively long, slightly concave transversely but rising toward the sinus to form an elevated ridge bordering the ambulacrum; upper edges of limbs truncate and gently beveled so that deltoids overlap radials; as a specimen weathers, the radio-deltoid suture migrates upward because of this overlapping; radio-deltoid sutures curved, forming three downward-projecting salients, a small one on each

[1] A fairly complete synonymy of *S. sayi* is given under the discussion of *S. sayi* (Shumard) *sensu lato*, so in the synonymy of each variety few references are made to mere fossil lists because it is impossible to tell what variety the writer was dealing with. Exceptions are made where the present writer has examined the specimens and where a list was compiled by the original nomenclator of the species or variety.

side and a larger one in the center. Sutures inconspicuous. Ornamentation at top of limbs consists of rows of small nodes arranged parallel to radio-deltoid suture but curving downward as they approach the interradial suture, extending downward on to the base of the radials. The nodes become smaller and more numerous downward, appearing as fine elevated longitudinal ridges.

Deltoids large, much thicker than the radials, comprising three-fourths the outside length of the theca; narrowly triangular in outline, less than two-fifths as wide as long, and widest just above the radio-deltoid suture. Lateral margins of deltoids bounded by a heavy, gently rounded node-studded ridge, terminating below at the radio-deltoid suture; ridges widest near periphery and in that vicinity gently beveled, but becoming narrow and prominently elevated at apex of plate. Each deltoid has a small circular pit near the apex. A well-defined nodose ridge extends downward along the middle of each plate and becomes more prominent near the radio-deltoid suture where it terminates.

Etheridge and Carpenter (1886, p. 225) have called attention to "several V-shaped obtuse ridges" on the deltoids "contiguous to and parallel with the radio-deltoid sutures." The deltoids seem to be built up on a series of imbricating layers. It appears that during the growth of the blastoid the size of the deltoids was increased periodically by the addition of a layer of plate substance from below and projecting downward beyond previously deposited material, thus accounting for the "V-shaped obtuse ridges."

The posterior deltoid is divided into epideltoid and hypodeltoid plates. The epideltoid is broken off in all of my specimens, but it is shown in Shumard's figures of the summit. Hypodeltoid elevated and arched forward over the anus to form a conspicuous hoodlike projection.

Ambulacra narrow, linear, the five occupying one-sixth of the equatorial circumference; laterally they appear to extend the height of calyx, but measured from stem-base to mouth around the outside of test they do not quite reach its entire length; adoral ends depressed below the level of the bordering lateral ridges, whereas near the equator they are level with the ridges, and near the radio-deltoid sutures they are slightly below the ridges because of the thickening of the deltoid plates near the lower ends; below the sutures the ridges again lower to the level of the ambulacra and the whole prominently elevated above the limbs of the radials. Lancet-plate roughly triangular in cross section, the two outer sides produced outward as a truncated wedge against which the side-plates rest, the inner portion resting on the upper edges of the inner walls of the hydrospires; perforated by a small longitudinal canal which is subcentral in position [not perforated by three canals as Etheridge and Carpenter (1886, p. 225, pl. 17, fig. 1) state or as they figure on plate 17]; lancet not entirely covered over by side-plates; proximally the exposed portion amounts to about one-fourth the width of the ambulacrum, but width decreases aborally until near the lips it is concealed; lancet grooved longitudinally and with transverse grooves along the sides of the main groove.

Side-plates average about 50 to a row (100 per ambulacrum) in my specimens; wedge-shaped transversely, thinning toward the exposed part of lancet; bodies about as long as wide, inner walls crenulated; handles concave upward for reception of outer side-plates. Outer side-plates about half the length of the side-plates, narrowly triangular in outline, resting in hollowed outer portions of side-plates. Ambulacral pores bordered adorally by handles of side-plates and aborally by the outer side-plates.

Four hydrospire folds beneath each ambulacrum, two on a side, the outer folds seemingly branch off of inner folds, and each pair is directed away from the median line at about 45 degrees; just

above the radio-deltoid suture they reach inward a distance equal to one-third the radius of theca; inner part of each fold swells into a sac-like expansion.

Ten slit-like spiracles occupying lateral notches in the proximal ends of deltoids; posterior spiracles separated from the rather large anus by thin partitions. Peristome covered over by an integument of small plates.

Remarks.—The largest of the known varieties of this species is distinguished by its large size and by its subglobose calyx, which is distinctly wider than high. *S. sayi* has been recorded in many faunal lists, but the variety *sayi* is not as abundant as some of the other varieties. It is noteworthy that this variety was one of the first in which the peristome was found to be covered.

Occurrence.—Shumard's type specimen came from "near the base of the Encrinital Limestone" (Burlington) at some unrecorded locality in Missouri. My specimens were collected from the base of the upper Burlington limestone at Hannibal, Missouri, and from the upper Burlington in a quarry south of Springfield, Missouri.

Types.—Shumard's figured specimen, the holotype, was probably lost in the fire at the University of Missouri in 1892. Hypotypes, Univ. Iowa, 793–797 inclusive.

SCHIZOBLASTUS SAYI (Shumard) var. BELLULUS Cline, n. var.

Plate 45, figures 1–8

Description.—Calyx moderate in size, elliptical, and higher than wide; measurements of five specimens show an average width of 10.1 mm. and a height of 11.2 mm. Elliptical in lateral view except for a gently truncated summit and a more severely truncated base. Periphery equatorial. Base small, concave, and less contracted than summit.

Radials reaching one-third the length of the calyx. Basals and radials completely visible but ends of deltoids only barely visible in basal view. Length of radials slightly exceeds width (in contrast to these measurements in the variety *sayi*); greatest width attained at radio-deltoid suture; bodies very short; limbs comparatively long, upper portion appearing truncated at surface. Interradial sutures inconspicuous. Radial ornamentation very pronounced and simulating that of the variety *sayi*.

Deltoids extending two-thirds the length of calyx, almost twice as long as wide, the greatest width being attained just above radio-deltoid suture; each lateral edge bordered by an elevated beveled ridge extending from radio-deltoid suture almost to apex; the beveling is greatest at mid-height of plate so that a semi-lanceolate area is produced on both sides of each ambulacrum. Proximally from the spiracles the ridges are low and broad and enclose a central pit-like depression.

Ambulacra occupy from one-fifth to one-sixth of circumference at equator; they reach the height of the calyx; adoral ends depressed slightly below level of bordering deltoidal ridges but at equator they are about level with the ridges, while the aboral ends lie slightly above these ridges; distal ends slightly overlapped by small hook-like projections on the radial lips. Lancet exposed almost the full length of ambulacrum; exposed portion about one-third the width of the ambulacrum adorally, but width decreases downward. About forty wedge-shaped side-plates resting jointly on each slope of lancet and adjacent sinus wall.

Peristome covered by a five-rayed integument composed of numerous fine plates (see pl. 45, fig. 4); each ray is ambulacral in position and extends downward to cover the proximal end of an ambulacrum as far down as the spiracles.

Remarks.—This variety is smaller than the variety *sayi*, is higher than wide, and the radials are proportionally larger, comprising about one-third the length of the calyx.

Occurrence.—Two of my specimens were collected from the upper portion of the Burlington limestone from a quarry within the city limits of Springfield, Missouri, where the species occurs in association with *Pentremites elongatus* and *Dizygocrinus rotundus;* four came from the lower part of the upper Burlington limestone in the quarries of the Atlas Portland Cement Company at Hannibal, Missouri; L. R. Laudon collected the other specimen from the lower Burlington at Gospel Run in southeastern Iowa.

Syntypes.—Univ. Iowa, 789–792.

SCHIZOBLASTUS SAYI (Shumard) var. OBESUS Cline, n. var.

Plate 44, figures 6–16

Description.—Calyx moderate to small in size; seven specimens average 10.9 mm. wide and 9.9 mm. high; depressed globose, contracted above and truncated below so that lateral profile is somewhat bell-shaped; roughly circular in transverse equatorial section, but below equator the section gradually becomes pentagonal because of gradual elevation of ambulacra above calyx. Periphery equatorial. Summit contracted; almost flat when integument is preserved but slightly concave when it fails of preservation. Base truncated, less contracted than summit.

Radials small, extending one-fourth length of calyx; a little wider than long, the widest portion is at height of junction of radio-deltoid and interradial sutures. Bodies short, limbs relatively long; upper ends truncated and convex upward. Radio-deltoid suture prominent, curving downward as interradial suture is approached, producing a salient in each suture. Portion of limbs adjacent to ambulacra raised into elevated longitudinal ridges. Interradial sutures inconspicuous. Radial ornamentation as in the variety *bellulus*.

Deltoids large, reaching three-fourths the length of calyx; one-half as broad as long; greatest breadth attained just above radio-deltoid suture; bordered laterally by a nodose ridge extending horizontally the length of the plate; the ridges on the posterior deltoid are conspicuous and just below the anus are connected by a transverse ridge. A ridge arises near the spiracles and extends downward along the median line of the plate to the radio-deltoid suture.

Ambulacra narrow, occupying slightly less than one-sixth the equatorial circumference, reaching the height of the calyx and protruding at the base; adoral ends depressed below the bordering deltoidal ridges, but at the equator they are level and below the equator they are elevated slightly above the ridges.

The larger specimens average about 40 side-plates to a row.

Remarks.—In size *S. sayi* var. *obesus* is comparable to *S. sayi* var. *bellulus*, but it differs from that variety in being wider than high, and in having relatively shorter radials. From *S. sayi* var. *sayi* it can be distinguished by its much smaller size.

Occurrence.—All of my specimens came from near the top of the lower Burlington limestone at Hannibal, and at Sedalia, Missouri.

Syntypes.—Univ. Iowa, 783–788.

SCHIZOBLASTUS SAYI (Shumard) var. POTTERI (Hambach), Cline, n. comb.

Plate 45, figures 21–25

Pentremites potteri HAMBACH, *1880*, St. Louis Acad. Sci., Trans., vol. 4, pp. 156, 157, pl. B, fig. 4.—GREGER, *1934*, St. Louis Acad. Sci., Trans., vol. 28, p. 166.

Schizoblastus sayi ETHERIDGE and CARPENTER (part), *1886*, Catalogue of the Blastoidea, pp. 223–226.—KEYES, *1894*, Missouri Geol. Survey, vol. 4, pt. 1, p. 138 (part), pl. 28, figs. 9*a*, *b*.—BATHER, *1899*, The species of Blastoidea, p. 65.—ROWLEY, *1904*, in G. K. Greene's "Contribution to Indiana paleontology," pt. 19, p. 196.

Cribroblastus potteri HAMBACH, *1903*, St. Louis Acad. Sci., Trans., vol. 13, pp. 41, 42, pl. 5, fig. 15.—GREGER, *1934*, St. Louis Acad. Sci., Trans., vol. 28, p. 130.

Schizoblastus potteri BATHER, *1908*, in G. Boehm's "Geologische Mitteilungen aus dem Indo-Australischen Archipel.," Neues Jahrb., Beilage-Band 25, pp. 317, 318.—CLARK, *1917*, Harvard Coll. Mus. Comp. Zoology, Bull., vol. 61, no. 9, p. 373.

Description.—Calyx medium in size, subglobular, slightly higher than wide; three relatively undeformed calyces average 11.8 mm. high and 10.7 mm. wide; the largest specimen is crushed laterally but it appears to have been about 15 mm. high and about 13.5 mm. wide. Summit moderately small, convex, strongly contracted. Base less contracted than summit, flat to slightly convex; lower portion protrudes beyond lower ends of ambulacra to form a rest for the upright calyx. Periphery equatorial.

Basalia roughly pentagonal in outline and in area equal to about one-half that of pentagon enclosed by lower ends of ambulacra. Interbasal and basi-radial sutures inconspicuous. Basal ornamentation consists of fine lirae, in general, parallel to basi-radial sutures. A noteworthy feature of the base is the thickened lower portion which has a shallow excavation at the center for the stem-base; this thickened lower portion tends to obscure the interbasal sutures, although it is weakly trilobed so as to faintly resemble a clover-leaf.

Radials small, reaching a little over one-fourth length of calyx; about as high as wide, although width may slightly exceed height; prominent in basal and lateral views but invisible orally. Bodies reaching almost one-half length of radials; forming a considerable portion of the base. Limbs truncated above, longer than wide, widest near upper ends, gradually narrowing below; faintly convex longitudinally, lower portion more strongly incurved to meet upper part of body, thus producing a "break" in the convexity of the plate a little below its mid-height; inner edge of limb forms a narrow longitudinal ridge bordering the sinus and terminating at the radio-deltoid suture. Outer edges of limbs smooth, forming inconspicuous interradial sutures. Upper ends of limbs convex upward, although in Hambach's original description (1880, p. 156) he stated that the limbs are not "arched at the junction of the deltoid piece," but in his illustration (see Hambach's pl. B, fig. 4) he pictured them as being decidedly convex upward as Etheridge and Carpenter (1886, p. 226) have noted, and likewise in a subsequent illustration (1903, fig. 15) he figured them as being convex upward. Each radial ornamented with fine parallel lirae; each lira is, in general, parallel to the outer border of the plate, but on the upper part of each limb they parallel the radio-deltoid suture, and are more widely spaced than lower down where they parallel the interradial sutures.

Deltoids large, reaching almost three-fourths length of calyx, about twice as high as wide; expanded above the spiracles to give the apex the outline of a spearhead. Lateral edges beveled gently to produce a narrowly lanceolate area on each side of sinus; this area is marked by longitudinal ridges in contrast to heavier transverse ridges which ornament the greater area of the plate. The epideltoid is the same shape as the apices of the other deltoids, but is slightly larger, more elevated, and seems to project inward a little more.

Ambulacra narrow, reaching about five-sixths length of calyx measured around the outside; at periphery their combined widths total about one-fifth the circumference of calyx. Throughout their lengths the ambulacra are elevated slightly above the sinus borders. In the average specimen there are 39 or 40 side-plates to a row, but in one overgrown individual there are about 50.

Remarks.—This variety of *Schizoblastus sayi* was considered by Hambach (1880, p. 156, pl. B, fig. 4), its nomenclator, to be specifically different from *sayi*, but soon after his description appeared Etheridge and Carpenter (1886, p. 226) denied its right to specific rank and suppressed it as a synonym of *S. sayi*. These authors also called attention to the fact that certain details of his description do not agree precisely with his illustration. I find that his illustration is quite accurate, and his description, though not all

that could have been desired, was better than the average specific description of that time.

When Bather (1899, p. 65) referred to *S. potteri* as being synonymous with *S. sayi* he was probably following Etheridge and Carpenter, because he later listed it as being distinct from *S. sayi* (1908, pp. 317, 318). After Hambach (1903, pp. 41, 42) had studied Shumard's type specimen of *S. sayi*, he still held that *S. potteri* was distinct from that species. The following year Rowley (1904, p. 196) referred to *S. potteri* as a synonym of *S. sayi*.

I hesitate to assign specific rank to *S. potteri* because of its close resemblance to some varieties of *S. sayi* and because its stratigraphic range is the same as that of *S. sayi*, but I think that it at least should be recognized as a distinct variety of *S. sayi*. The nearest ally to *S. sayi* var. *potteri* is the variety *verrucosus*, from which it differs in being smaller, in having a more protuberant base, and relatively longer radial bodies. From *S. sayi* var. *sayi* the variety *potteri* is distinguished by its much smaller size, more protuberant base (the base of *sayi* is concave), more globose form, and in having relatively longer radial bodies. *S. sayi* var. *potteri* is more nearly globular than the variety *bellulus*, the base is convex instead of concave, and the bodies of the radials are relatively longer. *S. sayi* var. *obesus* has a more depressed calyx, a concave base, and the radial bodies are relatively shorter. *S. moorei* has radials which reach half the length of the calyx and has a more prominent hypodeltoid.

Occurrence.—Hambach's figured specimen (the holotype) came from the Burlington limestone at Burlington, Iowa, and in my collection there are thirteen topotypes, all collected from the upper part of the Burlington formation by Frank Springer, and one other specimen which L. R. Laudon collected from the upper part of the formation in a quarry in the city of Springfield, Missouri.

Types.—Hambach's holotype was originally deposited at Washington University in St. Louis, but Prof. Courtney Werner[2] has recently written me that none of Hambach's types are now at Washington University and that Hambach had sold many of his fossils.

The fourteen specimens on which the above description is largely based are Univ. Iowa nos. 781, 782, and 3263.

SCHIZOBLASTUS SAYI (Shumard) var. VERRUCOSUS (Hambach) Cline, n. comb.

Plate 45, figure 12

Cribroblastus verrucosus HAMBACH, *1903*, St. Louis Acad. Sci., Trans., vol. 8, pp. 58, 59, pl. 5, fig. 3.

Schizoblastus sayi ROWLEY (part), *1904*, in G. K. Greene's "Contribution to Indiana paleontology," pt. 19, p. 196.

Schizoblastus? verrucosus BATHER, *1908*, in G. Boehm's "Geologische Mitteilungen aus dem Indo-Australischen Archipel.," Neues Jahrb., Beilage-Band 25, p. 318.

Description.—Calyx medium to large in size, subglobose, higher than wide; three of the least deformed thecas in my collection average 14.7 mm. high and 13.5 mm. wide. Summit convex, contracted. Base almost flat, appearing slightly truncated in side view; lower ends of ambulacra projecting slightly below stem-facet to form a quinquepod on which the upright calyx rests. Largest diameter equatorial.

Basalia small, comprising about one-half of pentagon enclosed by lower ends of ambulacra; flat or very slightly convex so that they are invisible or just barely visible laterally.

Radials small, slightly wider than high, reaching almost exactly one-fourth length of calyx; prominent in basal and lateral views but invisible orally. Bodies short, comprising a little over one-third length of radial. Limbs almost twice as long as wide, widest near upper ends and narrowing very gradually below; upper ends deeply truncated. Interradial sutures inconspicuous. Radial ornamentation as in *S. sayi* var. *potteri*, except that

[2] Personal communication, dated Nov. 11, 1934.

the ridges are broader, more nodose, and in some specimens a pair of conspicuous nodose ridges border the radial suture. Radio-deltoid sutures conspicuous; Hambach (1903, p. 58) remarked that the deltoids are "separated from the upper fork piece suture by a double linear depression"; the region bordering the radio-deltoid suture is somewhat conspicuous and may appear to be constricted, but the apparent constriction is due to varices of growth which may be on the upper portion of the limbs or the lower portion of a deltoid.

Deltoids large, reaching about three-fourths length of calyx, about twice as high as wide, narrowly triangular in outline but base slightly constricted so plate is widest just above radio-deltoid suture. All other features of deltoids, including ornamentation, are similar to those in *S. potteri*, except that the ridges are studded with coarser nodes or granules; Hambach called attention to this feature by naming this form *verrucosus*.

Ambulacra as in the variety *potteri* except that they are relatively longer and have 50 side-plates to a row.

Remarks.—Hambach (1903, p. 59) said that "this species is easily separated from its nearest relatives, as *Cribroblastus* [*Schizoblastus*] *sayi* (*Pentremites sayi* of Shumard) by its coarse granular surface." Rowley (1904) suppressed *Cribroblastus verrucosus* Hambach as a synonym of *Schizoblastus sayi* (Shumard). Bather (1908, p. 318) questionably referred *Cribroblastus verrucosus* Hambach to *Schizoblastus* with the statement that if it was closely related to *S. sayi* as Hambach had declared it to be, it was of course a *Schizoblastus*, "but on the description published it would be unsafe to base a more definite opinion."

I have seven specimens which seem to represent Hambach's species, and I regard them as representing a variety of *Schizoblastus sayi*. The surface is ornamented with nodular or granular ridges but they are no coarser than those on *S. sayi* var. *sayi* as that variety is defined in this paper. The closest relative to *S. sayi* var. *verrucosus* is the variety *potteri*, from which it differs in being larger, in having a less protuberant base, relatively shorter radial bodies, and coarser ornamentation. From the varieties *sayi*, *bellulus*, and *obesus* it is differentiated by a flat to protuberant base as compared with the concave base in all of these varieties. *S. moorei* is smaller, has a more protuberant base, and has relatively longer radials.

Occurrence.—Hambach's holotype came from the Burlington limestone at Allenton, Missouri. The specimens in the State University of Iowa collection were all collected by Frank Springer at Burlington, Iowa.

Types.—Hambach's type specimen has been lost. The specimens on which the above description is largely based are Univ. Iowa nos. 779 and 780.

SCHIZOBLASTUS ETHERIDGEI Cline, n. sp.

Plate 45, figures 17–20

Schizoblastus melonoides ETHERIDGE and CARPENTER (part), *1882*, Annals and Mag. Nat. Hist., 5th. ser., vol. 9, p. 246; (part), *1886*, Catalogue of the Blastoidea, pp. 226, 227, pl. 6, figs. 15, 16.

Description.—Calyx melon-shaped, elongated in young specimens to subglobular in gerontic individuals, but height always greater than width; measurements of three well-preserved specimens are: (a) width 9 mm., height 12.6 mm.; (b) width 11 mm., height 13 mm.; (c) width 16 mm., height 17.5 mm.; the largest specimen seen was 17 mm. wide and 19 mm. high. Outline roughly elliptical in lateral view and strongly decagonal in transverse section. Largest diameter equatorial or slightly above middle. Base small and contracted, almost flat, but stem-base may project slightly.

Basals relatively small, invisible or barely visible laterally.

Radials large, comprising at least four-fifths length of theca, clearly visible in a ventral view. Bodies short, amounting to 2 mm. in a radial 18 mm. long;

only partly visible laterally in specimens having a flat base. Limbs relatively long, concavely truncated above, limbs overlap deltoids so that the junction is a curved surface sloping adorally about 45 degrees; each limb has a broad, gently rounded depression extending lengthwise and located just inside the sinus and separated from it by a narrow ridge; bordering the sulcus on the outside is a sharply rounded ridge extending from radio-deltoid suture to lip of radial, the ridges of adjacent radials uniting to form a rounded ridge, widest at its center and gradually tapering to a point both adorally and aborally; each interradial suture located in the center of one of these compound ridges; in a transverse section these ridges appear equally as prominent as the ambulacra or they may even project slightly beyond.

Deltoids small, about a fifth of the calyx; exposed portions sublanceolate, about two-fifths as wide as long, widest about one-third the length of the plate above its base. Epideltoid imperfectly known; it is easily detached upon weathering. Hood of hypodeltoid prominent, so that it projects beyond the other deltoids.

Ambulacra narrow [I am following Wanner (1924, p. 5) in restricting the term ambulacrum so that it includes only the lancet and under lancet-plates, side-plates, and outer side-plates, and the brachioles], occupying only about one-sixth or one-seventh width of calyx, extending almost the length of calyx; adoral ends depressed below sinus but near equator they are level, and aborally they become elevated above the sinus borders except for the lips which form a hook-like projection over each aboral end. Lancet entirely concealed by side-plates from the distal ends to a point just above the equator where it becomes visible, and from this point proximally it widens so that near summit the exposed portion is about one-third the width of ambulac-

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EXPLANATION OF PLATE 45

With the exception of fig. 21, which is after Hambach, all of the figures on this plate are unretouched photographs.

FIGS. *1–8*—*Schizoblastus sayi* (Shumard) var. *bellulus* Cline, n. var. *1–4*, Right postero-interambulacral, left postero-ambulacral, basal, and summit views (×2) of one of the paratypes from the lower part of the Burlington limestone of southeastern Iowa; in fig. *4* note that the peristome in covered by a pentagonal integument composed of numerous small irregular plates. *5–8*, Posterior interambulacral, left postero-ambulacral, basal, and summit views (×2) of a paratype from the upper part of the Burlington limestone of northeastern Missouri; fig. *5* shows how the lateral slopes of the lancet are molded for the reception of the side-plates and also how the upper ends of the inner walls of the hydrospire folds support the lancet as do figs. *6* and *7*; in fig. *8* the suture which crosses transverse to the anus and divides the posterior interradius into epi- and hypodeltoids is clearly visible. (p. 271)

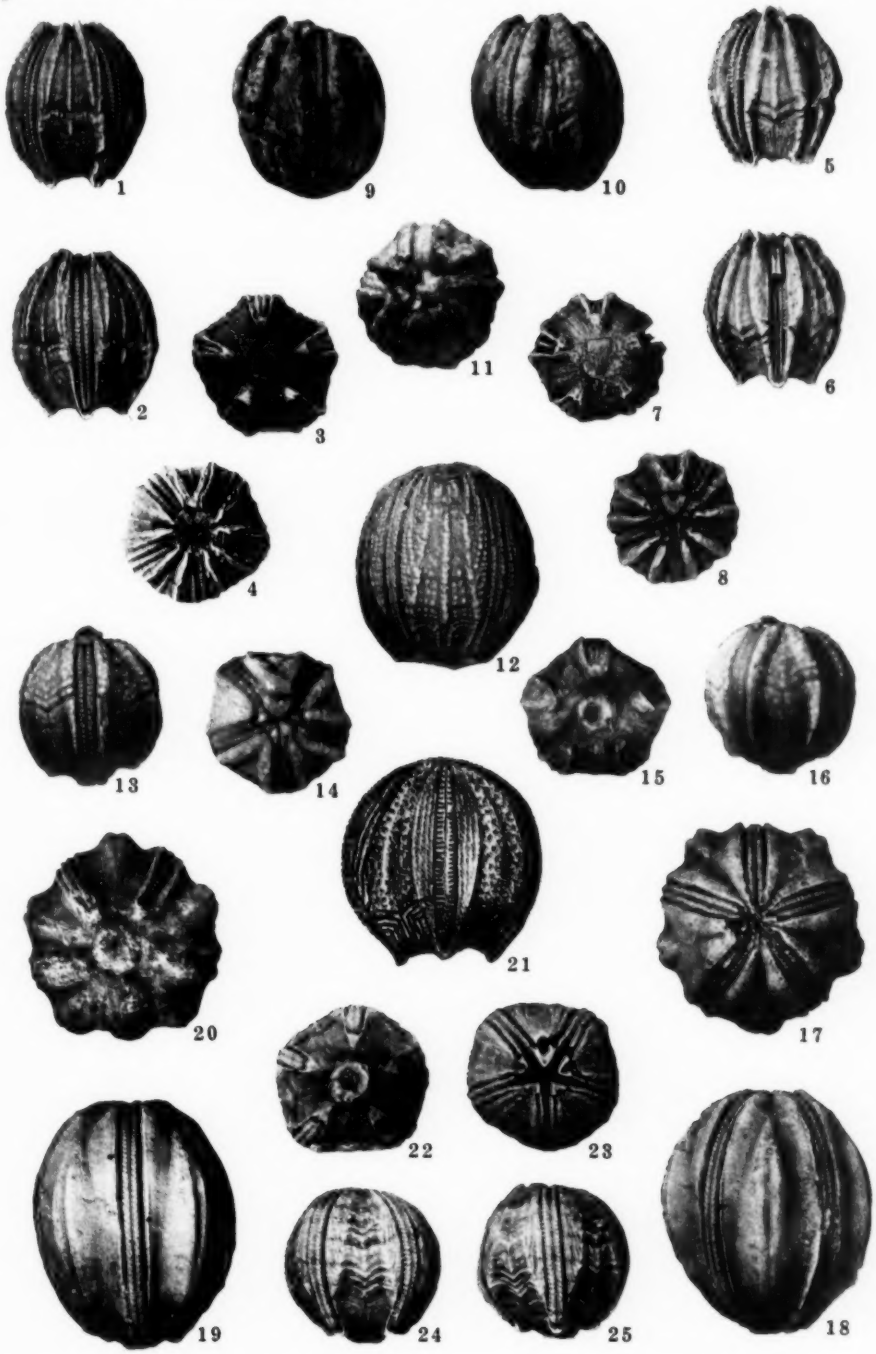
9–11—*Schizoblastus burlingtonensis* Cline, n. sp. Left postero-ambulacral, right postero-interambulacral, and summit views (×2) of the holotype and only known representative of the species; from the upper part of the Burlington limestone at Burlington, Iowa. (p. 280)

12—*Schizoblastus sayi* (Shumard) var. *verrucosus* (Hambach) Cline, n. comb. Lateral view (×2) of an interambulacrum. (p. 274)

13–16—*Schizoblastus moorei* Cline, n. sp. Antero-ambulacral, summit, basal, and left antero-interambulacral views (×2) of the holotype from the Reeds Spring limestone of southwestern Missouri. In fig. *13* the epideltoid and hypodeltoid plates project above the other deltoids. (p. 279)

17–20—*Schizoblastus etheridgei* Cline, n. sp. Summit, right postero-interambulacral, right antero-ambulacral, and basal views (×2) of the holotype, from the upper part of the Burlington limestone of Iowa. (p. 275)

21–25—*Schizoblastus sayi* (Shumard) var. *potteri* (Hambach) Cline, n. comb. From the upper part of the Burlington limestone of southeastern Iowa. *21*, Reproduction of Hambach's original illustration of the holotype (×2). *22–25*, Basal, summit, left antero-interambulacral, and left antero-ambulacral views of a hypotype (×2). (p. 272)



Cline, Lower Mississippian Blastoids

rum. It has not been possible from the sectioned specimens to tell if the lancet-plate is perforated by a longitudinal canal like the one in *S. sayi*. Walls of sinus appear to be grooved to receive distal edges of side-plates. Side-plates about 50 to a row; the largest specimen studied has 57. Bodies of side-plates about as long as wide; handles concave upward to receive outer side-plates. Outer side-plates longer than wide, and bordering the ambulacral pores distally and on the inside (the distal edge of the side-plate above forms the border of the pore on the adoral side).

Hydrospires imperfectly known; there seem to be two folds on each side of an ambulacrum as in *S. sayi*.

Ten small slit-like spiracles forming notches in proximal ends of deltoids. Apparently a thin partition separates the anus from the two adjacent spiracles.

Theca granulose; granules in rows approximately parallel to plate margins except where they meet the interradial sutures at a low angle.

Remarks.—It was this species that Etheridge and Carpenter (1886, pp. 226, 227, pl. 6, figs. 15, 16) figured and described as *Schizoblastus melonoides* (Meek and Worthen), and it was one of the two American species known at that time which they definitely referred to the genus *Schizoblastus*. A comparison of the original description and figures of *Granatocrinus melonoides* Meek and Worthen (1869, 1873) with the description and figures given by Etheridge and Carpenter shows that the forms studied by Etheridge and Carpenter differ noticeably in at least two respects from the species described by Meek and Worthen. The measurements of the type of *G. melonoides* are given by Meek and Worthen as 0.45 of an inch in height and 0.50 of an inch in breadth, and they state that the calyx is "a little wider than long." The drawings by Etheridge and Carpenter show a calyx one-fourth longer than wide; in the collection that I am studying there were seven complete specimens, two of which have been sectioned, of the form figured by Etheridge and Carpenter and they vary greatly in size, but in each the length is appreciably greater than the width. Etheridge and Carpenter note that

> the description of this species by Messrs. Meek and Worthen is clear and comprehensive, as all their descriptions are; but their figure fails to show the broad obtuse interradial ridges which are so characteristic of it, and assist in giving to it a roughly decagonal outline in cross section.

These interradial ridges are also very prominent in my specimens. It appears that the form described by Etheridge and Carpenter as *S. melonoides* (Meek and Worthen) and the seven specimens in my collection represent an unnamed species, which I am describing as *Schizoblastus etheridgei* Cline, n. sp.

With the exception of *G. melonoides* Meek and Worthen, this species can be differentiated from other species of *Schizoblastus* by its very short deltoids. In gross outline it resembles *S. burlingtonensis*, but the deltoids are much shorter.

Occurrence.—The specimens studied by Etheridge and Carpenter were collected by Charles Wachsmuth from the upper part of the Burlington limestone at Burlington, Iowa. Five of my specimens were collected by Frank Springer from the same horizon and locality; two others, slightly larger than the rest, were collected by L. R. Laudon from the *Pentremites* zonule of the Burlington limestone (near the top) near Elrick Junction, Iowa.

Types.—Univ. Iowa; holotype, 798; and paratypes, 799 and 3267.

SCHIZOBLASTUS LAUDONI Cline, n. sp.

Plate 44, figures 1–5

Description.—Calyx medium in size, ellipsoidal, distinctly higher than wide; the holotype, the only known representative of the species, is 16.5 mm. high and 12 mm. wide. Transverse section decag-

onal. Largest diameter equatorial. Base small and contracted; the stem-base projects a little below the ends of the ambulacra. Stem-facet about one-third the diameter of basalia; surrounded by a weakly trilobed area.

Basalia occupying about one-half of pentagon enclosed by lower ends of ambulacra; slightly convex and just visible laterally.

Radials reaching one-third length of calyx, higher than wide; prominent in basal and lateral views but invisible orally. Bodies reaching only one-seventh length of radials; limbs relatively long, inner edges deflected upward to form ridges bordering the sinus; upper ends truncated. Radio-deltoid suture obtusely V-shaped, with the relatively sharp apex directed downward. Interradial sutures inconspicuous. Radial ornamentation consists of fine lirae curving around lower portion of plate and then extending upward, at first parallel to the interradial sutures, but gradually diverging upward to become parallel to radio-deltoid suture.

Deltoids reach about two-thirds length of calyx; lower ends barely visible in basal view; narrowly subtriangular in outline; widest just above radio-deltoid suture, where width is less than one-half length; notched just below apex by the spiracles; lower edges rest on beveled upper edges of radials. Sides of deltoids raised into broadly rounded, narrowly lanceolate and longitudinally striate areas, which become very narrow and prominent at height of spiracles. Hypodeltoid raised above general level of summit. Central area of deltoids depressed and transversely concave; interrupted medianly by a longitudinal ridge.

Ambulacra linear, extending almost length of theca; at periphery their combined widths total about one-fourth circumference of calyx. Adorally ambulacra are depressed below level of confining edges of deltoids, but below spiracles they become level with sinus borders, and a little above radio-deltoid sutures they are elevated slightly above sinus and this relationship continues aborally. Exposed portion of lancet about one-third width of sinus at upper end, but width decreases downward, and at aboral end it is entirely overlapped by side-plates.

Side-plates, about 50 to a row. Outer side-plates resting in concavities in handles of side-plates, wedge-shaped in transverse section.

Ten slit-like spiracles occupying notches in lateral edges of deltoids and bordered ambulacrally by side-plates. Anus large and presumably circular.

Remarks.—The specific name *laudoni* is given in honor of Dr. L. R. Laudon of Tulsa University in recognition of his excellent work on the Mississippian formations of Iowa.

Schizoblastus laudoni has no close relatives in previously described representatives of the genus, although it is somewhat like *S. burlingtonensis*, described in this paper. The general form and proportions of the calyx (but not the plates) are so similar to *Granatocrinus* [*Cryptoblastus*] *shumardi* Meek and Worthen (1868), that it was in the State University of Iowa labeled as that species; it is differentiated from *Cryptoblastus shumardi* by its much larger deltoids; they are very small in *C. shumardi*, while in *S. laudoni* they extend two-thirds the length of the calyx. *S. laudoni* is distinguished from *S. burlingtonensis*, its nearest relative, by its larger and more elongate calyx, and in having the adoral ends of the ambulacra less depressed below the sinus borders. From *S. sayi* var. *potteri* it is readily differentiated by its larger size, more elliptical outline, and relatively larger shape. In *S. sayi* var. *verrucosus* the calyx is not so elliptical, the base seems to be less protuberant, and the radials are relatively shorter. *Schizoblastus? excavatus* (Rowley and Hare) has a concave base and the radials are relatively longer, reaching about one-half the length of the calyx.

Occurrence.—The only known repre-

sentative of this species was collected by L. R. Laudon from the *Physetocrinus* zonule of the lower Burlington limestone on Dolbe Creek in the SW. ¼ SW. ¼ sec. 26, T. 72 N., R. 2 W., in southeastern Iowa.

Holotype.—Univ. Iowa, 778.

SCHIZOBLASTUS MOOREI Cline, n. sp.

Plate 45, figures 13–16

Schizoblastus sayi (Shumard) s.l. CLINE (part), *1934*, Am. Assoc. Petroleum Geologists, Bull., vol. 18, no. 9, p. 1144.

Description.—Calyx medium in size, subglobular, higher than wide; holotype 11.6 mm. high and 11 mm. wide. Longitudinal section subcircular except for a protuberant stem-base and a towering hypodeltoid. Transverse section on adoral half of calyx decagonal, but below periphery it becomes increasingly pentagonal due to elevation of ambulacra. Largest diameter equatorial. Summit small, contracted, slightly concave so that apices of deltoids are hidden in a lateral view. Lower ends of ambulacra not so closely drawn together as upper ends, thus the pentagon enclosed by them is slightly larger than the summit area; the basalia project beyond extremities of ambulacra.

Basalia convex, wholly visible laterally; diameter equal to more than one-half that of pentagon enclosed by lower ends of ambulacra; the basi-radial sutures are indistinct, but the basalia appear to be pentagonal in outline.

Radials extend one-half length of calyx; prominent in basal view, almost entirely visible laterally, and faintly visible orally. Bodies short, incurved, just visible in lateral view; limbs relatively long; upper edges deeply truncated; inner portions deflected upward to form ridges bordering the sinus. Interradial sutures inconspicuous. Radials ornamented with alternating ridges and depressions which encircle lower end parallel to edge of plate, but upward they swing away from the interradial sutures to parallel the radio-deltoid sutures.

Deltoids relatively short for the genus, reaching slightly less than one-half length of calyx; widest below, narrowing gradually above; constricted just below apex by the spiracles, giving that portion of the plate the outline of a spear-head. Ridges border the radial sinus throughout its length. Deltoid ornamentation consists of coarsely nodose transverse ridges arranged parallel to radio-deltoid suture. Epideltoid shaped much like the spout or lip of a pitcher and is larger and more elevated (it is visible in a lateral view) than apices of the other deltoids; the adoralmost part projects over peristome and partly closes it posteriorly. Hypodeltoid produced into a hoodlike process which protects the anus aborally and incurved somewhat so that anus does not open directly above but rather from the side facing the peristome. Deltoids rest upon and overlap radials. Radio-deltoid suture obtusely V-shaped.

Ambulacra linear, reaching almost height of calyx; at periphery their combined widths comprise about one-fifth of the circumference of calyx. Lancet exposed throughout most of its length, being widest above and narrowing very gradually below until finally it becomes completely covered by side-plates. In the left postero- and right postero-ambulacra the upper ends are turned slightly aside by the large epideltoid and they curve around it and empty into the peristome. Side-plates and outer side-plates are poorly preserved in the holotype; there are about 35 plates to a row.

Ten slit-like spiracles occupy notches in lateral edges of deltoids; they are closed on the ambulacral side by the lancet-plate and possibly a few of the uppermost side-plates; the posterior pair open under the hoodlike process which protects the anus, but they open on the outside like those of the other deltoids, rather than being confluent with the anus.

Remarks.—The most diagnostic fea-

tures of *Schizoblastus moorei* are its protuberant base, its radials which reach half the length of the calyx, and its prominent epi- and hypodeltoid plates.

The globular calyx with its protuberant base resembles that of *S. sayi* var. *potteri*, but the radials in *S. moorei* are much longer and the hypodeltoid is much more prominent than in *S. potteri*, or its allied variety *S. sayi* var. *verrucosus*. There are at least two other species of *Schizoblastus* with protuberant bases with which *S. moorei* should be compared; *S. laudoni* has a more elongated calyx and relatively shorter radials; *S. etheridgei* is larger, has very tiny deltoids, and raised interambulacral areas.

Occurrence.—The holotype and two paratypes were collected by the writer from Moore's type section of the Reeds Spring limestone at Reeds Spring, in southwestern Missouri.

Types.—Univ. Iowa; holotype, 777; paratypes, 2557.

SCHIZOBLASTUS BURLINGTONENSIS
Cline, n. sp.
Plate 45, figures 9–11

Description.—Calyx elongate melon-shaped, the single specimen studied measuring 11.3 mm. wide and 13 mm. high; laterally it appears subelliptical, being flattened at poles; transversely it is strongly decagonal. Largest diameter equatorial.

Basals small, resting in a slight concavity so that in lateral view only extreme outer edges in interradial areas are visible.

Radials smaller than deltoids, about as broad as long, extending only about one-third length of calyx; in basal view they comprise most of field but orally they are invisible. Bodies short, less than one-fourth length of radial, partly visible laterally. Limbs relatively long, truncated above by obtusely V-shaped radio-deltoid suture. Interradial sutures lying in a longitudinal groove. Basiradial sutures not conspicuous. A low ridge borders the radial sinus. A deep furrow originates just above mid-height of limb and extends downward the length of limb, its course being parallel to ambulacral ridges but downward it cuts progressively closer to the interradial sutures. These incisions give a festoon-like appearance to remainder of limb, the elevated festoon-like areas ornamented with fine parallel ridges in lower portion of limb and becoming broader and nodose in upper portion where they turn and parallel the radio-deltoid suture.

Deltoids large, comprising about two-thirds length of calyx, lanceolate in outline, twice as long as wide, maximum width being attained a little above the radio-deltoid suture. Lateral edges bounded by a ridge which becomes increasingly elevated upward to height of spiracles, where the pair on each plate come together at a sharp angle. Lower one-third of deltoid ornamented with a longitudinal ridge, interradial in position, which extends from radio-deltoid suture gradually dying out upward. Hypodeltoid projects slightly over anus, as in the genotype of *Schizoblastus*.

Ambulacra narrow, occupying from one-fifth to one-fourth of circumference of calyx at equator, extending the height but not reaching quite the length of calyx. Proximal ends depressed below bordering deltoidal ridges, but they rise distally so that slightly below radio-deltoid suture they are level with ridges; distally they project above the ridges. Lancet almost covered throughout its length except for a short distance adorally where it is clearly visible. From 35 to 40 side-plates in a row. Bodies of side-plates about as long as broad; handles seemingly concave upward for reception of outer side-plates. Outer side-plates imperfectly known, but small, about half as wide as side-plates. Hydrospires unknown.

Spiracles ten, small and slit-like, opening through lateral notches in apex of deltoids and bordered on ambulacral side by lancet; posterior pair separated from anus. Anus large and circular and partly

covered over by a process arising from the hypodeltoid. Summit was covered in complete examples.

Remarks.—This species is represented in my collection by a single well-preserved calyx, which was collected by Frank Springer from the upper Burlington limestone at Burlington, Iowa. It resembles *S. etheridgei* so much in gross form that Springer had labeled it as belonging to that species. A close examination reveals that it differs from *S. etheridgei* in having deltoids that reach over half the length of the calyx (in contrast to the very short deltoids in *S. etheridgei*), that it lacks the prominent interradial ridges of *S. etheridgei*, and that the adoral ends of the ambulacra are much more depressed below the adjacent deltoidal ridges. *S. burlingtonensis* is distinguished from *S. laudoni*, its closest ally, by its smaller and more nearly globose calyx, and in having the adoral ends of the ambulacra distinctly depressed below the borders of the sinus. *S. sayi* var. *potteri* is smaller, has a more protuberant base, and has relatively short radials. *S.? excavatus* (Rowley and Hare) has a more concave base, and the radials are relatively longer.

Occurrence.—The holotype and only known representative of the species came from the upper Burlington limestone at Burlington, Iowa.

Holotype.—Univ. Iowa, 776.

REFERENCES

BATHER, F. A., *1899, The species of Blastoidea*, p. 65.

———, *1908*, in Boehm, G., "Geologische Mittelungen aus dem Indo-Australischen Archipel.": *Neues Jahrb.*, Beilage-Band 25, pp. 303–319, taf. 10, figs. 1–10; taf. 11, figs. 1*a*, 1*b*.

CLINE, L. M., *1934*, Osage formations of southern Ozark region, Missouri, Arkansas, and Oklahoma: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, no. 9, pp. 1132–1159.

ETHERIDGE, ROBT., JR., and CARPENTER, P. H., *1882*, On certain points in the morphology of the Blastoidea, with descriptions of some new genera and species: *Annals and Mag. Nat. Hist.*, 5th ser., vol. 9, pp. 213–252.

———, *1886, Catalogue of the Blastoidea* (London).

HAMBACH, G., *1880*, Contribution to the anatomy of the genus *Pentremites*, with description of new species: *St. Louis Acad. Sci., Trans.*, vol. 4, pp. 145–160.

———, *1903*, Revision of the Blastoidea, with a proposed new classification, and description of new species: *St. Louis Acad. Sci., Trans.*, vol. 13, pp. 1–67.

KEYES, CHARLES, R., and ROWLEY, R. R., *1897*, Vertical range of fossils at Louisiana (Missouri): *Iowa Acad. Sci., Proc.*, vol. 4, pp. 26–40.

LAUDON, L. R., *1929*, The stratigraphy and paleontology of the northward extension of the Burlington limestone: *Unpublished Master's Thesis, State Univ. of Iowa.*

MEEK, F. B., and WORTHEN, A. H., *1868, Illinois Geol. Survey*, vol. 3, pt. 2, pp. 498, 499, pl. 18, fig. 6*b* (but not 6*a*).

———, *1869*, Remarks on the Blastoidea, with descriptions of new species: *Acad. Nat. Sci. Philadelphia, Proc.*, pp. 83–91.

———, *1873, Illinois Geol. Survey*, vol. 5, pp. 468–470, pl. 9, figs. 1*a*, *b*.

MOORE, RAYMOND C., *1928*, Early Mississippian formations in Missouri: *Missouri Bur. Geol. and Mines*, 2d ser., vol. 21.

NILES, W. H., and WACHSMUTH, CHARLES, *1886*, Evidence of two distinct geological formations in the Burlington limestone: *Am. Jour. Sci.*, 2d ser., vol. 42, pp. 95–99.

PECK, R. E., *1929*, Blastoids from the Chouteau limestone (abstract): *Geol. Soc. America, Bull.*, vol. 40, p. 245.

ROWLEY, R. R., *1900*, Notes on the fauna of the Burlington limestone at Louisiana, Missouri: *Am. Geologist*, vol. 26, pp. 245–251.

———, *1904*, A review of Dr. G. Hambach's "Revision of the Blastoideae, etc.," in G. K. Greene's *Contribution to Indiana Paleontology*, pt. 19, p. 196.

———, *1908*, Geology of Pike County, Missouri: *Missouri Bur. Geol. and Mines*, 2d ser., vol. 8, pp. 36–42.

SHUMARD, B. F., *1855*, in Swallow, G. C., *First and second annual reports of the Geol. Survey of Missouri*, pl. B, figs. 1*a–d*.

VAN TUYL, FRANCIS M., *1925*, The stratigraphy of the Mississippian formations of Iowa: *Iowa Geol. Survey*, vol. 30.

WANNER, JOH., *1924*, Paläontologie von Timor, XIV Lieferung, XXIII. *Die Permischen Echinodermen von Timor*, Tiel II, pp. 40–43 (Stuttgart).

WHITE, C. A., *1860*, Observations upon the geology and paleontology of Burlington, Iowa, and its vicinity: *Boston Soc. Nat. Hist., Jour.*, vol. 7, no. 2, pp. 209–235.

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LOWER MISSISSIPPIAN MICRO-CRINOIDS OF THE KINDERHOOK AND OSAGE GROUPS OF MISSOURI

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ABSTRACT

Two new genera and nine new species of micro-crinoids are described from the Chouteau (Kinderhook) and Fern Glen (lower Osage) formations of Missouri. The relationships of the two new genera are uncertain and they are not referred to any family. The seven other species are referred to various genera under the Allagecrinidae and the Hypocrininae. The distribution and possible stratigraphic value of micro-crinoids are discussed.

No satisfactory grouping of crinoids into micro- and megascopic forms can be made except by arbitrary definition. Micro-crinoids ordinarily include only those forms that require moderate magnification to determine even the gross characters of the mature individuals. They are too small to be recognized in the field and are usually found in fine calcareous scrap, the washed residues of shale samples or, in comparatively rare cases of silicification, in the insoluble residues of limestones. In general, adult crinoid calyces more than 2 mm. high are grouped with megascopic forms. This paper deals only with micro-crinoids, all of which are well under 2 mm. in height.

Micro-crinoids and closely related megoscopic forms from Europe and Asia have received considerable attention through the studies of Wanner (1916, 1920, 1923, 1929), Wright (1932, 1933), and Yakovlev (1926, 1927, 1928). Several Pennsylvanian species from the United States have been described by Weller (1930). With the exception of Weller's work and the earlier description of the Kinderhookian *Allagecrinus americanus* Rowley (1895), there has been little in the literature of American micropaleontology to indicate that the tiny crinoids might be useful in stratigraphic work. The abundance of these small forms in the Fern Glen and Chouteau formations has suggested their possible value. Whether or not they will ever rival other micro-fossils can be determined only after a considerable store of information concerning the ease of identification and the stratigraphic range of the various species has been accumulated.

Apparently American micro-crinoids have been neglected because other micro-fossils are more abundant and have been considered a more ready aid to stratigraphic determination. The scarcity of specimens or limited vertical distribution cannot be cited as the cause. The University of Missouri collections of micro-crinoids have grown in a more or less haphazard manner, as crinoids were isolated during the search for more familiar micro-forms. However, they contain hundreds of specimens

ranging from Silurian to Pennsylvanian in age. Only within the past few months has any systematic search for crinoid-bearing horizons been made. Specifically, the collections include assemblages from the Bainbridge[1] (Silurian) of Missouri, the Haragan (Devonian) of Oklahoma, the Louisiana (Devonian?) (Branson and Mehl, 1933) of Missouri, the Bushberg and Chouteau (Kinderhook) of Missouri, the Fern Glen (lower Osage) of Missouri, the Welden (Kinderhook?) of Oklahoma, the Hampton (Kinderhook) of Iowa, and the Cherokee (Pennsylvanian) of Missouri. Although this list is not convincing of adequate vertical distribution because of the conspicuous gaps in the Middle Devonian and Middle and Upper Mississippian, there is little doubt but that these gaps will be readily filled. Only the Chouteau and Fern Glen faunas are included in this paper.

The conception that micro-crinoids represent the immature stages of associated megascopic crinoids has not been vigorously supported. Weller (1930) presents strong evidences against the possibility of his Pennsylvanian specimens representing immature crinoids. There has, however, been considerable discussion by Yakovlev (1928) and Wanner (1929) as to whether these small forms represent arrested development (primitive crinoids) or degenerate forms, descendants from more complex ancestors.

In general, the micro-crinoids are referable to the Allagecrinidae and Hypocrininae. The Allagecrinidae include small monocyclic larviform crinoids consisting of a basal circlet, five symmetrical radials, five orals, and, in one genus, an anal series. The primitive position of this family has been questioned only by Wanner (1929, p. 13), who found that among the Timor representatives of *Allagecrinus* Carpenter and Etheridge (J. Wright, 1933, p. 205, refers most of these forms to *Callimorphocrinus*[2] J. M. Weller) five-armed species occur stratigraphically higher than many-armed species with axillary radials. This question was discussed by Weller (1930, p. 12), who concluded that the Allagecrinidae were primitive forms. The primitive character of the family is not disproved by the conclusive evidence that it underwent simplification in the number of arms, as pointed out by Wanner, nor by the probable development of *Callimorphocrinus* from *Allagecrinus* through the loss of the anal series and uniform growth of the radials. Although these two genera evidently occur together in the Scottish Lower Carboniferous limestones, it is significant that in the United States *Allagecrinus* without *Callimorphocrinus* occurs in the Chouteau and the Lousiana formations and that *Callimorphocrinus* occurs without *Al-*

[1] Micro-crinoids from the Bainbridge were collected by a graduate student in geology. Inasmuch as these so closely resemble Fern Glen crinoids, I am inclined to question the validity of the Silurian reference.

[2] Weller's genus "Kallimorphocrinus" is to be corrected under the Rules of Nomenclature (see Art. 19, Appendix F, and compare Opinion 81) to read "Callimorphocrinus."—Editor.

lagecrinus in the higher Fern Glen and the Cherokee formations.

The other group of micro-crinoids represented is referred to the subfamily Hypocrininae Wanner (1929, p. 38). This subfamily, represented abundantly in the Permian of Timor, is characterized by Wanner as undergoing reduction and atrophy of the arms and radials and a displacement of the orals and anal opening. Descending from the more complicated Cyathocrinidae, it undergoes successive simplifications until it attains the armless stage with no radials as represented by *Coencystis* Girty (1908). Wanner's conclusions were questioned by Yakovlev (1928), who studied nearly a thousand specimens of *Hemistreptacron abrachiatum* Yakovlev, from the Permo-Carboniferous of the Ural Mountains. Yakovlev concluded that the Hypocrininae were primitive and not degenerate crinoids. His conclusions are discussed in detail by Wanner (1929, p. 85) who reviews the evidence and gives strong arguments for the degeneracy of the Hypocrininae. Although Kinderhook Hypocrininae are not sufficiently known to warrant conclusions, the fact that two of the most simplified genera, *Dichostreblocrinus* J. M. Weller and *Coencystis* Girty, occur in rocks as old as the Fern Glen may be significant. Occurring with them are simple monocyclic forms, described in the following pages under two new generic names.

Decision between degeneracy and arrested development can hardly be made at this time. The best plan for determining the true nature of this peculiar subfamily of crinoids seems to lie in the direction of much additional descriptive work, particularly on Devonian, Mississippian, Pennsylvanian, and possibly Silurian forms.

The drawings and retouched photographs used for illustrations in this paper were prepared by Mrs. Vaona Hedrick Peck. The graduate students in the Department of Geology of the University of Missouri, especially Mr. Philip Morey, have contributed many of the specimens and have been constantly on the watch for productive samples.

The manuscript was received by the editor of the Journal June 10, 1935.

SYSTEMATIC DESCRIPTIONS

Family ALLAGECRINIDAE Carpenter and Etheridge (emend. J. Wright), 1933

Genus ALLAGECRINUS Carpenter and Etheridge, 1881

ALLAGECRINUS ROWLEYI Peck, n. sp.

Plate 47, figures 15–20, 23, 24, 27, 28

Calyx subpyriform, small, few specimens attaining a height of more than 1.3 mm., with a maximum diameter of approximately four-fifths the height. Basal circlet small, forming about one-fourth or less of the total length, expanding gradually from small stem facet to the union with radials. Number of basals unknown, the only observed suture under left posterior radial (*LPR*). *R* longer than wide, forming a little more than half the total length, of almost uniform width on immature armless forms but becoming differentiated with growth of the calyx until at maturity *LPR* and *RPR* are wider than the other three radials and *AR* and *LAR* are narrowest. Immature forms armless, the outer edges of orals meeting flush

with outside edges of radials. Arms introduced on *RPR* and *LAR* first, then on *LPR* and *RAR*, and finally on *AR*. No axillary radials observed. Oral dome prominent in the young, making up almost one-third of the entire height of calyx, becoming less prominent with growth until on the mature form it makes up less than one-sixth of the total height. Orals concave with raised borders. Concavity of *PO* interrupted just above the center of the plate by a short ridge or tubercle that probably represents the hydropore. Anal series introduced about the same time as the formation of the arm facet on *AR* and originating in an excavation on the left shoulder of *RPR*. There is no definite opening into the calyx on immature forms, but after the anal plate or the excavation for its reception appears, a definite anal opening between *PO* and *RPR* is present. Ornamentation consisting of minute pits over the entire surface, never coarse, and decreasing but slightly with growth of calyx.

Remarks.—Although *Allagecrinus americanus* Rowley (1895) was discovered more than 40 years ago, this is the first time the genus has been recognized in North America outside of one Louisiana limestone locality about one mile south of Louisiana, Pike County, Missouri. *A. americanus* Rowley and *A. rowleyi* are nearly identical in size and resemble each other closely. In *A. americanus* the *LAR* is always narrower than the other four, the ornamentation is coarse on the immature forms, the radials are sufficiently convex laterally to give a pentagonal appearance when viewed from the base, and the majority of the calyces are more slender than in *A. rowleyi*.

The specific name is given in honor of the late Prof. R. R. Rowley, of Louisiana, Missouri.

Occurrence.—Shale partings in the lower 6 feet of the Chouteau (Kinderhook) limestone, just south of Providence and about 3 miles northeast of Brown's Station, both in Boone County, Missouri.

Holotype and paratype.—Univ. Missouri, E-4-1, E-4-2.

Genus TROPHOCRINUS Kirk, 1930

TROPHOCRINUS EXSERTUS Peck, n. sp.

Plate 47, figures 10–14, 21, 22, 25, 26

Calyx subconical to subpyriform, most specimens slightly asymmetrical, the diameter from the right anterior radius to the left posterior inter-radius slightly greater than the antero-posterior diameter; small, measuring 0.9 mm. or less from the lower end of the basal circlet to the top of the oral dome, height about one-fourth greater than maximum width. Basal circlet low, forming less than one-fourth of total height, expanding gradually from a very small stem facet to the union with the radials, sutures unknown. Radials considerably longer than wide, forming approximately two-thirds the total height of the calyx; of equal width, or *RAR* slightly narrower than the other four. The adjacent halves of *LPR* and *LAR* produced outward and upward to form the peculiar pouch that is the distinguishing character of the genus. Immature forms armless and without the extensions of *LPR* and *LAR*. At maturity each radial bears a small arm facet, the facets appearing on all five radials simultaneously. Tegmen formed by five orals of approximately equal size and similar shape, *PO* slightly larger than the other four. Orals concave with raised borders, the concavity of *PO* interrupted near the center by a small tubercle that probably marks the location of the hydropore. No anal opening observed. The calyx is entirely covered by very minute pits.

Remarks.—*Trophocrinus tumidus* Kirk of the Welden limestone of Oklahoma has only one arm facet and has unequal radials of which *LAR* and *LPR* are widest.

In association with his type species, Kirk (1930) found other minute crinoids that agree in many details with *T. tumidus*, but lack the prolongation of *LAR* and *LPR* that is the outstanding pecu-

liarity of the genus. He suggested that this might indicate a "sexually dimorphic type"; that the extension of the two *R* formed what might be termed a "brood pouch" and thus would be present only on the females.

Chouteau shale partings have yielded a considerable number of micro-crinoids among which two forms, *Allagecrinus rowleyi* Peck and *Trophocrinus exsertus*, may be easily recognized. Associated with these two species are specimens that agree in every detail with *T. exsertus* except that they lack any evidence of a prolongation of *LR* (pl. 47, figs. 21, 22). None of the specimens from the Chouteau has the entire pouchlike structure preserved and on many its former presence is marked only by a small but unmistakable triangular facet on *LR*. There is little possibility of confusing specimens from which the radial extensions have been broken off with specimens that never possessed them. Although, if found alone, these forms without the pouch would be referred to *Callimorphocrinus* J. M. Weller, as Wright (1933) has interpreted that genus, I am referring them to *T. exsertus*.

The evidence is not entirely conclusive concerning Kirk's interpretation of the peculiar pouchlike cavity formed by the extension of the left radials. Bather (1934) implied that the identification as a brood pouch is questionable. As it is obviously impossible to prove the cause of this radial extension or how the pouch may have functioned, it would be better to designate it as the marginal pouch. However, it is quite significant that in association with each of the three known occurrences of species of *Trophocrinus* (Welden, Chouteau, Fern Glen) with the marginal pouch, there have been found individuals agreeing in other details, but lacking the pouch.

There is a slight variation in the position of the marginal pouch. Almost all individuals have it on the adjacent halves of *LAR* and *LPR*. On one of the specimens figured (pl. 47, figs. 13, 14) it does not affect *LPR* and is confined to *LAR* overlapping slightly on to *AR*.

Occurrence.—Shale partings in the lower 6 feet of the Chouteau limestone (Kinderhook). About 3 miles northwest of Brown's Station and just south of Providence, both in Boone County, Missouri, in association with *Allagecrinus rowleyi*.

EXPLANATION OF PLATE 46

All figures ×28.

FIGS. *1, 2—Callimorphocrinus puteatus* Peck, n. sp. Posterior and summit views of the holotype. (p. 288)

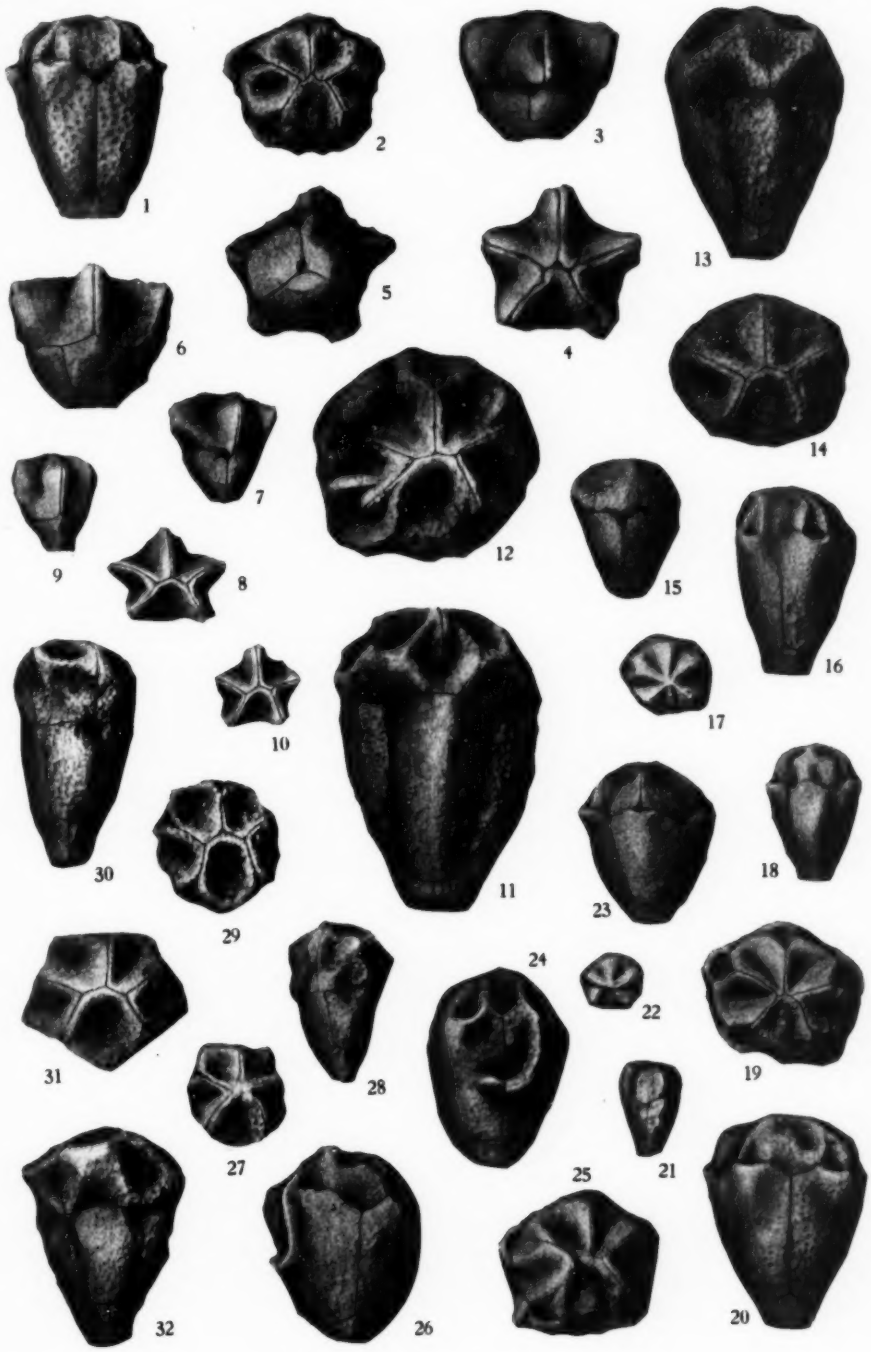
3–10—Octocrinus inconsuetus Peck, n. gen. and n. sp. *3–6*, Posterior, summit, basal, and anterior views of the holotype. *7, 8*, Posterior and summit views of paratype. *9, 10*, Left anterior and summit views of paratype. (p. 291)

11–15—Coencystis moreyi Peck, n. sp. *11, 12*, Lateral (*LPB*) and summit views of holotype showing diamond-shaped concavities along the interoral sutures. *13, 14*, Lateral (*LAB*) and summit views of paratype showing flat area along interoral suture. *15*, Posterior lateral view showing small anal opening. (p. 289)

16–22—Callimorphocrinus pristinus Peck, n. sp. *21, 22*, Posterior lateral and summit views of small armless paratype. *17, 18*, Summit and lateral (*LPR*) views of small paratype with arm facets on *RPR* and *LAR*. *16*, Lateral (*RPR*) view of larger paratype. *19, 20*, Summit and posterior lateral views of holotype. (p. 287)

23–26—Trophocrinus corpulentus Peck, n. sp. *23*, Lateral (*LPR*) view of specimen with five arm facets and without marginal pouch. *24, 25, 26*, Lateral (left posterior interradius) summit, and posterior lateral views of the holotype, showing the break formed by the loss of the marginal pouch. (p. 287)

27–32—Dichostreblocrinus minutus Peck, n. sp. *27, 28*, Summit and posterior lateral views of small paratype. *29, 30*, Summit and posterior lateral views of slender paratype showing displacement of orals and anal opening. *31, 32*, Summit and posterior lateral views of holotype. (p. 289)



Peck, Mississippian Crinoids

UNIV. OF MICH.

Holotype and paratypes.—Univ. Missouri, E-4-3, E-4-4.

TROPHOCRINUS CORPULENTUS Peck, n. sp.

Plate 46, figures 23–26

Calyx subglobular, asymmetrical, diameter from the right anterior radius to the left posterior interradius slightly greater than the antero-posterior diameter; small, the holotype measuring a little less than 1 mm. in height, and 0.8 mm. maximum diameter. Basal circlet low, inconspicuous, forming about one-tenth the total height, expanding rapidly from a very small stem facet to the union with the radials, the shortness and rapid expansion causing the aboral end of the calyx to appear rounded; sutures of basal circlet unknown. Radials of equal width, forming about three-fifths the total height of the calyx. On the holotype the adjacent halves of *LPR* and *LAR* show the scar caused by the loss of the marginal pouch. Arm facets borne only by *LAR*, *LPR*, and *RPR*. Orals concave with raised borders along the inter-oral sutures. On *LPO* this concavity is very shallow. The *PO* bears a small hydropore near the center. No anal opening observed. Calyx covered with very small pits.

Remarks.—This description is based on a single specimen, the holotype. The species differs from *T. tumidus* Kirk, from the Welden limestone of Oklahoma, in that the latter has only one arm facet, is much higher than wide, has fairly conspicuous basals, and has unequal radials. *T. corpulentus* differs conspicuously from *T. exsertus* Peck, from the Chouteau limestone of Missouri, in that the latter is one-fourth higher than wide and the basals form nearly one-fourth the total height.

In the same small shale sample that contained the holotype there were three other specimens that are tentatively referred to the same species (pl. 46. fig. 23). They are about 0.8 mm. high and from 0.6 to 0.7 mm. maximum width. These three specimens are almost as wide as high, have short, inconspicuous basals, and are ornamented by very small pits. They differ from the holotype in that none of them shows any evidence of the marginal pouch. One of the specimens, although shorter than the holotype, possesses five arm facets. These three specimens differ from the young of *Callimorphocrinus pristinus* Peck in shape, general proportions, and ornamentation, but it is possible that they represent another species of *Callimorphocrinus*.

Occurrence.—Fern Glen (lower Osage) formation about three-fourths of a mile south of Kimmswick, Ste. Genevieve County, Missouri, along Mississippi River bluffs.

Holotype.—Univ. Missouri, E-5-1.

Genus CALLIMORPHOCRINUS J. M. Weller, 1930

CALLIMORPHOCRINUS PRISTINUS Peck, n. sp.

Plate 46, figures 16–22

Calyx subpyriform, small, few specimens attaining a height of over 1.1 mm. and a maximum width of more than 0.9 mm. Basal circlet low, forming approximately one-fifth the total height, expanding gradually from a small stem facet to the union with the radials, sutures unknown. Radials forming more than half the total height, about one-third longer than wide, of uniform width, slightly convex both longitudinally and laterally, the calyx possessing a circular outline when viewed from the base. Immature forms armless, the outer edges of the orals meeting flush with the outside of the radials, the arm facet introduced almost simultaneously at various stages of growth on all radials except *AR*. There is a slight tendency for the facets on *LAR* and *RPR* to be larger and better developed than those on *LPR* and *RAR*. On mature forms all radials bear facets. Orals five, comprising approximately one-third the total height on the immature armless forms, but decreasing in prominence with later growth; *PO*

slightly larger than the other four, and bearing a hydropore. No anal opening evident. Calyx ornamented over the entire surface with small pits.

Remarks.—The above description is based on about 100 specimens of various sizes, all from one small sample.

There is some question as to the systematic position of the crinoids that are here referred to the genus *Callimorphocrinus*. In size, shape, character of arm facets, and orals, they resemble North America species of *Allagecrinus* Carpenter and Etheridge more closely than they do the Pennsylvanian species of *Callimorphocrinus* J. M. Weller. The only distinction between these two genera, as interpreted by J. Wright (1933), is that in *Allagecrinus* the radials are not of uniform width and an anal series is introduced on the left shoulder of *RPR* at maturity, whereas *Callimorphocrinus* fails to develop an anal series and the radials are of nearly uniform width. Inasmuch as the anal series is not introduced on specimens of *Allagecrinus* until maturity, the only possible distinction between young specimens of *Allagecrinus* and *Callimorphocrinus* is in the presence or absence of radials of uniform width. On these very minute specimens this distinction is sometimes difficult to make.

In the species here described a considerable number of specimens have well-developed facets on all five radials and, therefore, are considered mature. Inasmuch as there is no indication of an anal plate they are logically referred to *Callimorphocrinus*. Furthermore, careful measurements have indicated that their radials are of perfectly uniform width, whereas on both *Allagecrinus americanus* Rowley and *A. rowleyi* Peck the radials are quite diverse in width by the time five arm facets are developed.

Occurrence.—Fern Glen (lower Osage) formation, about three-fourths of a mile south of Kimmswick, Ste. Genevieve County, Missouri, on Mississippi River bluffs.

Holotype and paratypes.—Univ. Missouri, E-5-3, E-5-4.

CALLIMORPHOCRINUS PUTEATUS Peck, n. sp.
Plate 46, figures 1, 2

Calyx depressed-ovate, small, the holotype emasuring 1 mm. in height and about 0.8 mm. in width at the arm facets. Basal circlet very short, making up only about one-tenth of the total height, expanding very slowly from a comparatively large stem facet to the union with the radials, sutures unknown. Radials forming approximately seven-tenths the total height, uniform in width, convex laterally with depressed inter-radial sutures making the calyx pentagonal in outline when viewed from the base. Immature specimens armless. All of the radials of mature specimens, except perhaps *AR*, bear arm facets. Orals slightly concave with raised borders, the convexity of *PO* interrupted near the center by a small tubercle which is interpreted as the hydropore. Entire surface of the calyx ornamented with comparatively large, deep, irregularly spaced pits.

Remarks.—The above description is based on two specimens. One of these does not possess arm facets and is obviously immature. The other specimen, the holotype, has only four arm facets, but it is probable that fully mature specimens have an arm facet on *AR*. It seems to be characteristic of the North American Kinderhook Allagecrinidae for *AR* to be the last to develop an arm facet. The species is referred to the genus *Callimorphocrinus* because of the uniform width of the radials and lack of evidence of an anal plate.

The distinguishing characters of the species are the depressed-ovate shape, the very short basal circlet, and the comparatively strong ornamentation.

Occurrence.—Fern Glen (lower Osage) formation about three-fourths of a mile south of Kimmswick, Ste. Genevieve County, Missouri, on Mississippi River bluffs.

Holotype.—Univ. Missouri, E-5-5.

Family CYATHOCRINIDAE Roemer (emend. Wachsmuth and Springer) Subfamily HYPOCRININAE Wanner

Genus DICHOSTREBLOCRINUS J. M. Weller, 1930

DICHOSTREBLOCRINUS MINUTUS Peck, n. sp.

Plate 46, figures 27–32

Calyx subpyriform to subconical with a pentagonal or circular cross-section; small, averaging approximately 1 mm. in height with a maximum diameter of 0.6 to 0.8 mm. Infrabasal disk small, forming about one-fifth the total height, composed of five plates of equal size, expanding very gradually from a small stem facet to the union with the basals. Basals prominent, uniform, longer than wide, forming approximately one-half the total height, truncated above and rounded below, gently convex both longitudinally and laterally, a cross-section of the calyx in this region possessing an almost circular outline. The upper right corner of posterior basal (*PB*) deeply excavated and the upper left corner of *RPB* slightly excavated for a comparatively large anal opening. Oral dome prominent, forming about one-third of the total height of the calyx and all of the gently convex oral surface. Orals five, subequal, except that *PO* is somewhat larger than the other four, rising from the truncated upper surface of the basals and forming lateral walls of the calyx for about one-half their total length and then bending in abruptly at approximately a right angle to form the gently convex oral surface. On the summit, the orals are concave with raised borders, the concavity grading outward into a distinct swelling or knob that gives the pentagonal outline to many of the specimens. Entire surface covered by medium to coarse pits.

Remarks.—*D. minutus* is the second recorded species of this peculiar genus. The type of the genus, *D. scrobiculus* J. M. Weller from the Pennsylvanian of Indiana, differs from *D. minutus* in that the latter is the smaller, has a more prominent oral dome, and presents a circular rather than a pentagonal outline through the basals.

D. minutus is based on eight specimens, several of which show no indication of the anal opening. However, this feature is so distinct on the holotype and one on the paratypes (pl. 46, figs. 30, 32) that there can be no doubt concerning its location.

Occurrence.—Fern Glen (lower Osage) formation about three-fourths of a mile south of Kimmswick, Ste. Genevieve County, Missouri, on Mississippi River bluffs.

Holotype and paratypes.—Univ. Missouri, E-6-2, E-6-3.

Genus COENCYSTIS Girty, 1908

COENCYSTIS MOREYI Peck, n. sp.

Plate 46, figures 11–15

Calyx subpyriform, small, the holotype measuring 1.5 mm. in height and 1.1 mm. maximum diameter. Infrabasals five, very small, forming less than one-tenth the total height, the stem facet occupying the entire lower surface. Basals prominent, uniform, nearly twice as high as wide, rounded below and almost truncated above, gently convex longitudinally and more strongly convex laterally, the interbasal sutures distinctly depressed. The basals form from slightly more than one-half to somewhat less than two-thirds the total height of the calyx. The upper right corner of *LPB* and the upper left corner of *PB* slightly excavated for the small, inconspicuous anal opening. Orals five, shifted approximately 30° to the left and located almost radially, *PO* the largest and somewhat asymmetrical. Four of the interoral sutures are regular, but the greater width and asymmetry of *PO* causes the suture bounding it on the left to originate above the almost exact center of *LPB*. Oral

dome prominent, forming almost one-half the total height of the calyx on specimens 0.8 mm. high, diminishing proportionately with the growth of the calyx until it forms about one-third the total height in adult specimens. The dome is inflated and bulbous on immature specimens, but with growth of the calyx a small diamond-shaped flattened area develops along the interoral sutures as the periphery of the calyx. With continued growth, this flattened area becomes slightly concave. On the holotype these areas appear to have been fields for the attachment of brachial muscles. Anal opening small, inconspicuous, surrounded by *PO*, *PB*, and *LPB*.

Remarks.—For descriptive purposes this species has been oriented according to Wanner's interpretation (1929, p. 79). This interpretation assumes that the orals have shifted to the left until they are almost radial in position and that the posterior oral rests on the right half of the left posterior basal and the left half of the posterior basal.

There are several puzzling features in the interpretation of the calyx of *C. moreyi*. The anal opening is extremely small and difficult to determine. It is indistinguishable on most specimens, but has been questionably identified on two individuals. On the comparatively large holotype careful cleaning exposed a very minute circle of clear calcite at the upper extremity of the suture between *PB* and *LPB*. This is interpreted as the filling of a small anal opening. The small specimen illustrated on Plate 46, fig. 15, shows an unmistakable opening at the upper extremity of the suture between *PB* and *LPB*. Several other specimens give no indication of an opening at that point. However, among the eight specimens of *Dichostreblocrinus minutus* Peck described above and obtained from the same sample as *C. moreyi*, only two individuals show the anal opening. On those two individuals the openings are quite prominent and unmistakable, and it seems safe to assume that they have been present and subsequently filled on the other specimens. If the identification of the anal opening on specimens referred to *C. moreyi* should prove erroneous, a new genus for the reception of these forms must be proposed. There is no sign of any other opening into the calyx. On all other species referred to *Coencystis* Girty the orals have been displaced until they are exactly radial in position. The difference of 6° in the displacement of the orals is hardly sufficient for generic distinction.

Brachial muscle fields along the interoral sutures and entirely on the orals are not unknown, as Wanner has figured and described them on *Tenagocrinus sulcatus* Wanner (1929, pl. 2, figs. 13, 14) from the Permian of Timor. In that case, however, small, poorly developed radials are situated directly below the arm attachment. Presumably the arms developed on the radials and subsequently migrated to the orals. Although this study has included specimens of *C. moreyi* ranging from 0.8 mm. in height, with no flattened areas along the interoral sutures, to the holotype, 1.5 mm. in height, with definite concave diamond-shaped areas along the interoral sutures, there has been no evidence found of radials entering into the formation of the calyx. The formation of crinoid arms along interoral sutures seems unlikely, but no alternative explanation for the concave diamond-shaped areas illustrated on the holotype seems plausible.

Another interpretation of the calyx of *C. moreyi* assumes that it is a monocyclic form composed of five small basals, five large radials, and five orals. According to this interpretation the species represents a member of the Allagecrinidae that has not yet reached maturity and, therefore, has not developed arms. However, certain features of the calyx are opposed to this interpretation. All known Kinderhook Allagecrinidae develop arm facets while less than 1 mm. in height. No Allagecrinidae are known with the basal circlet divided into five plates. The

association of *Dichostreblocrinus minutus*, n. sp., an unquestioned representative of the Hypocrininae, establishes this subfamily as present in the Fern Glen. The presence of the diamond-shaped concavities along the interoral sutures, a modification that must have had something to do with obtaining food, would preclude the possibility of arm facets on the subadjacent plates which are interpreted as basals.

Occurrence.—Fern Glen (lower Osage) formation, about three-fourths of a mile south of Kimmswick, Ste. Genevieve County, Missouri, on Mississippi River bluffs.

Holotype and paratypes.—Univ. Missouri, E-6-4, E-6-5.

CRINOIDS OF UNCERTAIN POSITION

Genus OCTOCRINUS Peck, n. gen.

Small monocyclic crinoids with no radial plates. Basals three, of subequal size, position uncertain. Orals five, large, the posterior oral slightly longer and wider than the other four and separating the inner ends of the right and left posterior orals. Anal opening small, situated between the basal and oral circlets just below the right side of the posterior oral, and at the upper extremity of one of the basal sutures.

Genotype.—*Octocrinus inconsuetus* Peck, n. sp.

OCTOCRINUS INCONSUETUS Peck, n. sp.

Plate 46, figures 3–10

The calyx of the holotype is 0.66 mm. high and of slightly greater maximum breadth. The calyx expands rapidly upward from a moderate-sized stem facet for about half the total height and then less rapidly along the sharply ridged interoral sutures to the gently convex oral surface. Basal circlet comparatively large, comprising almost half the total body height, consisting of three basals of subequal size. Interbasal sutures occur under the right side of *PO* directly under the anal opening, under the anterior side of *LPO*, and almost under the center of *RAO*. Orals large, comprising more than half the body height, deeply concave with sharply raised outer borders making the interoral sutures divide pronounced ridges that give the calyx a distinct pentagonal outline when viewed from above. Small anal opening under the right side of *PO* at the upper end of one of the interbasal sutures. The surface of the calyx is very rough and irregular, probably because of weathering.

Remarks.—This genus and species is based on seven specimens from one locality. They range in size from 0.4 to slightly greater than 0.65 mm. in height. All of the specimens agree in relative proportions, and in the number and arrangement of plates. One individual is larger than any of the others and differs from them in shape. It is considered the holotype and the description is drawn largely from it. The smaller specimens are considered immature representatives, but they may represent another species or variety.

Octocrinus inconsuetus differs markedly from all species of the Hypocrininae in that it is clearly monocyclic with three sutures extending from the proximal edges of the orals to the center of the stem facet. Although species of *Atremacrinus* Wanner also possess only two circles of plates, there are no sutures in the lower circlet, and it can be explained as the fusion of all the infrabasals and basals. This explanation cannot be applied where the sutures extend the full length of the lower circlet of plates as in *Octocrinus*.

In size, shape, general appearance, and location of the anal opening, *O. inconsuetus* closely resembles *Amphipsalidocrinus scissurus* J. M. Weller and *Tytthocrinus comptus* J. M. Weller (1930), both from a Pennsylvanian limestone in Warren County, Indiana. According to Weller's interpretation *T. comptus* possesses an infrabasal disk, five basals, and five orals. The interoral sutures coincide

in position with the interbasal sutures. *A. scissurus* is composed of an infrabasal disk, five basals, five small radials that do not meet laterally, and a large oral dome of five plates.

Occurrence.—Fern Glen (lower Osage) formation about three-fourths of a mile south of Kimmswick, Ste. Genevieve County, Missouri, on Mississippi River bluffs.

Holotype and paratypes.—Univ. Missouri, E-7-1, E-7-2.

Genus PASSALOCRINUS Peck, n. gen.

Small monocyclic crinoids. Basals three, elongate, of almost equal size, the unfused right anterior basal slightly narrower than the other two. Radials unequal and asymmetrical, all except *RPR* arm-bearing; *LPR*, *RAR*, and *AR* the largest, angular below, the lateral edges sloping to a point at the interbasal sutures, almost truncated above; *RPR* very small, situated above the level of the other radials, truncated below and angular above, the upper point inserted between the edges of the adjacent orals at a higher level than the upper edges of the other radials; *LAR* of medium size, almost symmetrical. Orals unequal and asymmetrical, the posterior the widest and longest, the inner end inserted between the points of the postero-lateral orals so that they do not reach the center.

Genotype.—*Passalocrinus triangularis* Peck, n. sp.

PASSALOCRINUS TRIANGULARIS Peck, n. sp.
Plate 47, figures 1–9

Calyx small, elongate conical with a gently convex oral surface, with a maximum height of 0.9 mm. Basals of almost equal size, very elongate, making up approximately one-half the total height of the calyx on the larger specimens, very convex laterally, the convexity rising gently from the interbasal sutures to a fairly sharp ridge at the center of each of the three basals, thus making the calyx triangular in outline when viewed from below. Radials very unequal and asymmetrical, grading in size from the large *LPR* through *RAR*, *AR*, *LAR*, down to the very small symmetrical *RPR*, all except *RPR* bearing small arm facets. Orals asymmetrical, their shape modified so that the interoral sutures meet in the centers of the radials; slightly concave with raised borders along the interoral sutures. Calyx unornamented.

Remarks.—The above description is based on the study of about 75 fairly well preserved specimens. They are remarkably similar in form and size, with

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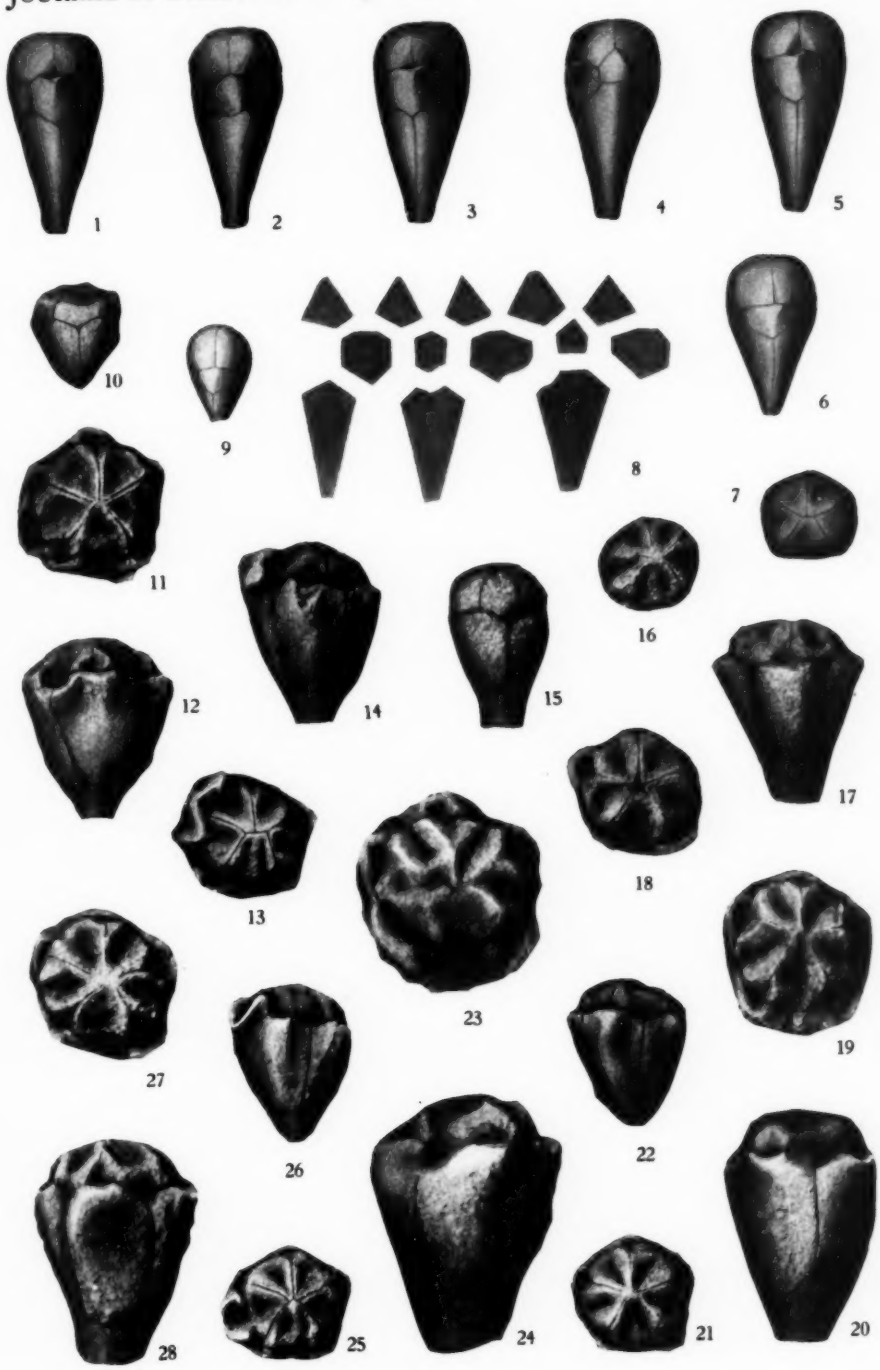
EXPLANATION OF PLATE 47
All figures ×28, except as noted in figures 1–9.

FIGS. *1–9*—*Passalocrinus triangularis* Peck, n. gen. and n. sp., ×35. *1–5*, *7*, Anterior, left anterior, left posterior, right posterior, right anterior, and summit views of the holotype. *6*, *9*, Lateral (*LPR*) views of small paratypes showing growth stages. *8*, Plan drawing of the calyx. (p. 292)

10–14, *21*, *22*, *25*, *26*—*Trophocrinus exsertus* Peck, n. sp. *10*, Lateral view of small armless paratype without marginal pouch. *11*, *12*, Summit and lateral (*LPR*) views of holotype. *13*, *14*, Summit and lateral (*LPR*) views of paratype with marginal radial growth affecting only *LAR* and *AR*. *22*, *23*, Posterior lateral and summit views of specimen without the marginal pouch. *25*, *26*, Summit and lateral (*LPR*) views of paratype. (p. 285)

15–20, *23*, *24*, *27*, *28*—*Allagecrinus rowleyi* Peck, n. sp. *15*, *16*, Posterior lateral and summit views of small armless paratype. *17*, *18*, Lateral (*LPR*) and summit views of paratype with facets on *RPR* and *LAR*. *19*, *20*, Summit and posterior lateral views of paratype with five arm facets, the facet on *AR* very small, and the beginning of the excavation on *RPR* for the anal series. *23*, *24*, Summit and lateral (*RPR*) views of the holotype. *27*, *28*, Summit and lateral (*LPR*) views of paratype with five arm facets and slight excavation on the left shoulder of *RPR* for the reception of the anal series. (p. 284)



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the exception of a few immature calyces with short basals. The figured specimens do not have arm facets on *LAR*, but several specimens with this facet well developed have been observed and one is included in the paratypes.

P. triangularis bears no close relationship to any other recorded crinoid. The very small *RPR*, situated high in the calyx, gives the impression that it may be the upper part of a compound plate. All of the material at hand was examined with this possibility in view and none showed the slightest indication of a suture setting off an interradial plate. The radials of the Allagecrinidae are unequal in size, but they are always symmetrical and all arm-bearing.

P. triangularis resembles *Metasycocrinus* Wanner from the Permian of Timor in possessing a very small shrunken *RPR*, but *Metasycocrinus* is a dicyclic crinoid and is referred to the Hypocrininae.

Occurrence.—Fern Glen (lower Osage) formation, about three-fourths of a mile south of Kimmswick and at Brickeys, Ste. Genevieve County, Missouri. Long basal plates referable to this genus were collected in lower Chouteau limestone, about three miles northwest of Providence, Boone County, Missouri.

Holotype and Paratypes.—Univ. Missouri, E-7-4, E-7-5.

REFERENCES

Branson, E. B., and Mehl, M. G., *1933*, Conodonts from the Grassy Creek shales of Missouri: *Univ. of Missouri Studies*, vol. 8, no. 3, pp. 179–183.

Bather, F., *1934*, *Geol. Zentralbl., Abt. B, Palaeontologie*, vol. 4, p. 167.

Carpenter, P. H., and Etheridge, R., Jr., *1881*, On *Allagecrinus*, the representative of a new family from the Carboniferous limestone series of Scotland: *Annals Mag. Nat. Hist.*, 5th ser., vol. 7, pp. 281–298, pls. 15, 16.

Girty, George H., *1908*, The Guadalupian fauna: *U. S. Geol. Survey, Prof. Paper 58*, p. 108, pl. 27, figs. 19–22.

Kirk, Edwin, *1930*, *Trophocrinus*, a new Carboniferous crinoid genus: *Washington Acad. Sci., Jour.*, vol. 20, pp. 210–212.

Rowley, R. R., *1895*, Description of a new genus and five new species of fossils from the Devonian and sub-Carboniferous rocks of Missouri: *Am. Geologist*, vol. 16, pp. 217–223.

———, *1908*, The geology of Pike County: *Missouri Bur. Geology and Mines*, 2d ser., vol. 8, p. 67, pl. 16, figs. 39–41.

Wanner, J., *1916*, Die permischen Echinodermen von Timor, 1 Teil, *Paläontologie von Timor*, 6 Lief.

———, *1920*, Ueber armlose Krinoiden aus dem jungeren Palaeozoikum: *Geol. mijnb. genootsch. Nederland en Kolönien, Verh., Geol. ser.*, Teil 5, pp. 21–35.

———, *1923*, Die permischen Krinoiden von Timor: *Jaarb. mijnwezen Ned.-Indië, Verh.* 1921, 3d Gedeelte.

———, *1929*, Neue Beitrage zur kenntnis der permischen Echinodermen von Timor, I *Allagecrinus*, II *Hypocrinites: Dienst mijnb. Ned.-Indië, Wetensch. Med.*, No. 11.

Weller, J. Marvin, *1930*, A group of larviform crinoids from Lower Pennsylvanian strata of the Eastern Interior Basin. *Illinois Geol. Survey, Rept. Inv.* no. 21.

Wright, James, *1932*, The Scottish species of *Allagecrinus*: *Geol. Mag.*, vol. 69, pp. 337–366, pls. 23–25.

Wright, James, *1933*, Two new crinoids from the Scottish Carboniferous limestones, with notes on the Allagecrinidae: *Geol. Mag.*, vol. 70, pp. 193–208, pls. 13, 14.

Yakovlev, N. N., *1926*, Faune des Echinodermes du Permo-Carbonifère de l'Oural à Krasnooufimsk I: *Comm. Géol. U.S.S.R., Bull.*, vol. 45, pp. 51–57, pl. 1.

———, *1927*, Faune des Échinodermes du Permo-Carbonifère de l'Oural à Krasnooufimsk II: *Comm. Géol. U.S.S.R., Bull.*, vol. 46, pp. 181–191, pl. 6.

———, *1928*, Sur la tératologie et la morphogénie des crinoides abrachiates. *Acad. Sci. U.S.S.R., Comptes rendus.*, pp. 313–315.

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BIBLIOGRAPHY AND INDEX TO NEW GENERA, SPECIES, AND VARIETIES OF FORAMINIFERA FOR THE YEAR 1934

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In the following Bibliography 335 publications dealing exclusively or partly with foraminifera are listed, 324 of the papers being issued in 1934, 1 in 1931, 2 in 1932, and 8 in 1933.

The index to new foraminifera erected during the year 1934 includes 1 new family, 3 new subfamilies, 2 new tribes of subfamilies, 20 new genera, 3 new subgenera, 340 new species, 83 forms to which the *nomenclatura aperta* has been applied, and 21 *nomina nuda*.

Homonyms—According to Articles 11, 34 and 35 of the *International Rules of Zoological Nomenclature*, the following forms are **homonyms** and, consequently, should be renamed by their respective authors:

Bolivina marginata Cushman, 1918, var. *gracilis* Cushman and Kleinpell, preoccupied by *B. gracilis* Cushman and Applin, 1926.

Candeina triloba Jedlitschka, preoccupied by *C. nitida* d'Orbigny, 1839, var. *triloba* Cushman, 1921.

Cibicides depressus Tolmachoff, preoccupied by *C.* (*Truncatulina*) *depressus* (d'Orbigny, 1839).

Frondicularia karreri Oppl, preoccupied by *F.* (*Flabellina*) *karreri* (Berthelin, 1880).

Fusulina tunetana H. Douvillé, 1934, var. *elongata* H. Douvillé, preoccupied by *F. elongata* Shumard, 1858.

Fusulinella uralica Doutkevitch, 1934, var. *inflata* Doutkevitch, preoccupied by *F. inflata* Colani, 1924.

Gallowaiina, Chen, n. gen., preoccupied by *Gallowayina* Ellis, 1932.

Lagena marginata (Walker and Boys, 1784), var. *spinifera* Earland, preoccupied by *L. aspera* Reuss, 1862, var. *spinifera* Chapman, 1895.

Lagena quadrilatera Earland, 1934, var. *striatula* Earland, preoccupied by *L. sublagenoides* Cushman, 1913, var. *striatula* Cushman, 1913.

Lagena semilineata J. Wright, 1886, var. *spinigera* Earland, preoccupied by *L. bicarinata* (Terquem, 1882), var. *spinigera* Heron-Allen and Earland, 1922, and by *L. reniformis* Sidebottom, 1913, var. *spinigera* Sidebottom, 1913.

Nodosaria acuta Eichenberg, preoccupied by *Dentalina acuta* d'Orbigny, 1826. (As *Dentalina* d'Orbigny, 1826, originally has been designated as a subgenus of *Nodosaria* Lamarck, 1812, according to Article 6 of the *International Rules of Zoological Nomenclature*, it becomes coordinate and is subject to the same nomenclatorial rules as the genus itself.)

Nodosaria communis d'Orbigny, 1826, var. *larva* Earland, preoccupied by *N. larva* Carsey, 1926.

Nodosaria spinosa Eichenberg, preoccupied by *Dentalina spinosa* d'Orbigny, 1846, by *N. spinosa* Neugeboren, 1852, and by *N. spinosa* Berry, 1928.

Nodosaria tenuistriata Eichenberg, preoccupied by *Dentalina tenuistriata* Terquem, 1866, and by *N. tenuistriata* Franke, 1925.

Planulina elegans Tolmachoff, preoccupied by *P. elegans* Ehrenberg, 1844, and 1854.

Trochammina alternans Earland, preoccupied by *T. irregularis* (d'Orbigny, 1850), var. *alternans* Jones and Parker, 1860.

Uvigerina striatella Brotzen, preoccupied by *U. striatella* Reuss, 1851.

Observations on Nomenclature.—Badly chosen or to a certain degree improper names are given to the following forms, which may cause confusion on account of homophony. Under the *Rules* these names must stand in spite of very slight differences from other names.

Borelia Sorrentino (not *Borelis* Montfort, 1808).

Lepidocyclina (*L.*) *ariana* Cole and Ponton (not *L. ariena* Berry, 1932).

Quinqueloculina subquadrata Tolmachoff (not *Q. subquadra* Hada, 1931).

Robulus lenticularis Tolmachoff should not be confused with *Cristellaria lenticula* Reuss, 1850, or with *Robulina lenticula* Stache, 1864.

Unfortunate misprints, such as *Pulivina* (for *Pulvinulina*, which has become a *nomen caducum*) and *Margulina* (for *Marginulina*) constantly used in Brotzen (No. **27** of the following Bibliography), should be avoided.

Much more care must be exercised in future in creating new specific and subspecific names. Authors should always remember that the best specific and varietal name for a new form of foraminifer is and remains a Latin

adjective which is short, concise, euphonic, and of easy pronunciation, and which agrees grammatically with the gender of the generic name.

Before publishing a form as a new one, each author should ascertain beyond any doubt that the proposed new name for the species or variety in question is really new to science and has not been in use within the same genus (or subgenus) and its synonyms, nor with any of its varieties.

The overproduction of new generic, specific and varietal names in foraminifera, especially within the last few years, should be a strong warning that nomenclature, in the first place, is an eminent mnemonic help in discriminating the enormous richness, multiformity and variability of forms. The use of Greek or Latin roots for genera and of Latin adjectives or substantives for species and varieties has the great advantage of international understanding. Well-chosen Latin terms for specific and varietal forms among foraminifera are more useful and intelligently illustrative than some more easily derived geographical or patronymic epithet through which no correct idea of the characteristics and general appearance of a new form can be conceived. Patronymic names, moreover, should only be given as a well-deserved and meritorious honor to such scientists and persons who have considerably contributed to the advancement of the knowledge of foraminifera. The habit of recent years in attaching names of classmates, occasional collectors, governors, spouses and college friends to new species or varieties of foraminifera is pure charlatanism and should be entirely abolished. Cramming a maximum of meaning into one single Latin word is still the best method to be followed in scientific name-giving.

The numbers in bold-face type following the author's name in the Index refer to the publications of the preceding Bibliography.

I. BIBLIOGRAPHY

1. ANDREW, GERALD, The structure of the Esh-Mellaha Range (Eastern Desert of Egypt, 27°30′–28°N.): *Inst. Égypte, Bull.* 16, fasc. 1, pp. 47–59, pls. 1–3.
2. ANDRUSOV, DIMITRIJ, Sur la trouvaille de *Siderolites vidali* Douvillé dans les Carpathes occidentales: *Soc. géol. France, Compte rendu*, fasc. 6, 19 mars, pp. 82–84.
3. ANONYMOUS, "Discovery" report on foraminifera of South Georgia (correction of errors): *Nature*, London, vol. 133, p. 562.
4. ARBENZ, PAUL, Die helvetische Region: *Geol. Führer Schweiz*, fasc. 2, pp. 96–120, pls. 1, 2.
5. ARBENZ, PAUL, Engelberg-Furrenalp-Nieder Surenen-Engelberg: *Geol. Führer Schweiz*, fasc. 10, pp. 768–775, 1 text fig.
6. ARBENZ, PAUL, Engelberg-Jochpass-Engstlenalp-Frutt-Melchtal-Sarnen: *Geol. Führer Schweiz*, fasc. 10, pp. 776–789, 2 text figs.
7. ARNI, P., Das Alter des Prätigauflysches: *Naturf. Gesell. Bern, Mitt.*, vol. 25., pp. 20, 21, Nov. 1933.
8. ASHAUER, H, and HOLLISTER, J. S., Ostpyrenäen und Balearen: *Gesell. Wiss. Göttingen, Math.-nat. Kl., Abh.* 3, Heft 10, pp. 1–208, 44 text figs., pls. 1–8.

ATANASIU, I., *see* MACOVEI, G., and ATANASIU, I.

9. BADEN-POWELL, D. F. W., On the marine gravels at March, Cambridgeshire: *Geol. Mag.*, vol. 71, no. 839, pp. 193–219, 5 text figs.
10. BARBAT, W. F., and GALLOWAY, JOHN, San Joaquin clay, California: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, pp. 476–499, 2 text figs.
11. BARBAT, W. F., and JOHNSON, F. L., Stratigraphy and foraminifera of the Reef Ridge shale, upper Miocene, California: *Jour. Paleontology*, vol. 8, pp. 3–17, pl. 1.

BARGMANN, H. E., *see* HOARE, CECIL A., and BARGMANN, H. E.

12. BARKER, R. WRIGHT, Some notes on the genus *Helicolepidina* Tobler: *Jour. Paleontology*, vol. 8, pp. 344–351, pl. 47.
13. BARKER, R. WRIGHT. Some notes on the genus *Helicolepidina* Tobler (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 374.
14. BARRABÉ, L., Sur la trangression tertiaire qui a recouvert la partie orientale de la Guadeloupe: *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 758–760.
15. BARRABÉ, L., Sur les formations sédimentaires de la Guadeloupe et leur substratum: *Soc. géol. France, Compte rendu*, fasc. 4, pp. 50, 51.

BATALLER, J. R., *see* Supplement for the year 1932.

16. BECK, P., Niesen: *Geol. Führer Schweiz*, fasc. 8, pp. 618–623.

BECKER, Helmut, *see* GÖTZINGER, P., and BECKER, HELMUT.

BERKALOFF, EUGÈNE, *see* SOLIGNAC, M., and BERKALOFF, EUGÈNE.

17. BERMUDEZ, PEDRO J., Un género y especie nueva de foraminíferos vivientes de Cuba: *Soc. cubana hist. nat., Mem.*, vol. 8, no. 2, pp. 83–86, 3 text figs.
18. BERTHIAUME, SHERIDAN A., Middle Eocene foraminifera in western Oregon (Abstract): *Paleont. Soc., Pacific Coast Branch, List of Papers 33d Ann. Meeting*, p. 48.
19. BIROT, PIERRE, Sur les poudingues nummulitiques dans leurs rapports avec les massifs calcaires sud-pyrénéens, entre Llobregat et le Segre: *Soc. géol. France, Compte rendu*, fasc, 2, pp. 11–13.
BLAINPIED, B. W., *see* HAZZARD, R. T., and BLAINPIED, B. W.
20. BLUMENTHAL, M. M., Die Grenzverhältnisse zwischen sub- und penibetischer Zone im Grenzgebiet der Provinzen Malaga, Sevilla und Cadiz (Strecke Almargen-Olvera): *Eclogae geol. Helvetiae*, vol. 27, pp. 147–180, 4 text figs., pl. 5.
21. BLUMENTHAL, M. M., West-Rhätikon; Die Falknis- und Scesaplana-Gruppe: *Geol. Führer Schweiz*, fasc. 13, pp. 961–969, 1 text fig.
22. BLUMENTHAL, M. M., Ost-Rhätikon; Der Querschnitt des St. Antönien-Tales: *Geol. Führer Schweiz*, fasc. 13, pp. 970–975, 1 text fig.
23. BOISSEVAIN, H., Études géologiques et géomorphologiques d'une partie de la Vallée de la Haute Segre (Pyrénées Catalanes): *Univ. Utrecht, Dissertation*, pp. 1–170, 27 text figs. 3 pls.
24. BONTE, A., Observations sur les foraminifères du tuffeau landénien de Lille (Porte de Gand): *Soc. géol. Nord, Annales*, vol. 59, pp. 67–82, 8 text figs., pl. 3.
25. BRODSKII, A. L., and SAMSONOVA, M. F., To the question of the genesis of "loess" in the district of Chimkent (Kazakstan Russia): *Univ. Asia Media, Tashkent, Geog.*, fasc. 14, pp. 1–15, 2 pls. (Russian with English summary, pp. 14, 15.)
26. BROTZEN, FRITZ, Vorläufiger Bericht über eine Foraminiferenfauna aus der schwedischen Schreibkreide (Mucronatensenon): *Geol. fören. Stockholm, Förh.*, vol. 56, pp. 77–80.
27. BROTZEN, FRITZ, Foraminiferen aus dem Senon Palästinas: *Deutsche-Palästina-Ver., Zeitschr.*, pp. 28–72, pls. 1–4.
BUCK, DAMIAN, *see* JEANNET, A., and BUCK, DAMIAN.
28. BUXTORF, AUGUST, Über ein Transgressionskonglomerat des Lutétien im östlichen Pilatusgebiet: *Eclogae geol. Helvetiae*, vol. 27, pp. 369, 370.
29. BUXTORF, AUGUST, Über ein Transgressionskonglomerat des Lutétien im östlichen Pilatusgebiet: *Schweizer. naturf. Gesell, Verh.*, pp. 318, 319.
30. BUXTORF, AUGUST, Axenstrasse (Sisikon-Flüelen): *Geol. Führer Schweiz*, fasc. 10, pp. 761–767, 1 text fig.
31. CADISCH, JOOS, *Geologie der Schweizeralpen*, 383 pp., 47 text figs., Zürich, Beer and Co.
CALVEZ, JEAN LE, *see* LE CALVEZ, JEAN.
CAMPBELL, ARTHUR S., *see* CUSHMAN, J. A., and CAMPBELL, ARTHUR S.
32. CAUDRI, C. M. B., *Tertiary deposits of Soemba*, 223 pp., 2 maps, 5 pls., 19 text figs., Amsterdam, H. J. Paris.
33. CAYEUX, L., The phosphatic nodules of the Agulhas bank (A study of submarine geology): *South African Mus., Annals*, vol. 31, pt. 1, pp. 105–136, 4 pls.
34. CAYEUX, L., Les difficultés de la classification des sediments calcaires anciens: *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 2041–2044.
CHABAKOV A. V., *see* KHABAKOV, A. V.
35. CHAPMAN, FREDERICK, and CRESPIN, IRENE, The paleontology of the Plantagenet beds of Western Australia: *Roy. Soc. Western Australia, Jour.*, vol. 20, pp. 103–136, pls. 6–11.
36. CHAPMAN, F., HOWCHIN, W., and PARR, W. J., A revision of the nomenclature of the Permian foraminifera of New South Wales: *Roy. Soc. Victoria, Proc.*, vol. 47, new ser, pt. 1, pp. 175–189, 5 text figs.
37. CHAPMAN, F., PARR, W. J., and COLLINS, A. C., Tertiary foraminifera of Victoria, Australia; The Balcombian deposits of Port Phillip, Part III: *Linnean Soc., Jour., Zoology*, vol. 38, no. 262, pp. 553–577, pls. 8–11.
38. CHEN, S., Fusulinidae of South China, Part I.: *Palaeontologia Sinica*, ser. B., vol. 4, fasc. 2, pp. 1–185, pls. 1–16, 36 graphs.
39. CHEN, S., A new species of Fusulinidae from the Meitien limestone: *Geol. Soc. China, Bull.*, vol. 13, no. 2, pp. 237–240. pl. 1.
40. CHEN, S., Fusulinidae of the Huanglung and Maping limestones, Kwangsi: *Nat. Research Inst. Geology, Mem.* 14, pp. 33–54, pls. 6–8.
CHU, S., *see* LEE, Y. Y., and CHU, S.
CHU, S., *see* LI, C., and CHU, S.
41. CIZANCOURT, Mme. DE, Matériaux pour la stratigraphie du Nummulitique dans le Désert de Syrie: *Soc. géol. France, Bull.* (5), vol. 4, pp. 737–758, pls. 44–46, 1 text fig. (Published October, 1935.)
42. COLE, W. STORRS, Oligocene orbitoids from near Duncan Church, Washington County, Florida: *Jour. Paleontology*, vol. 8, pp. 21–28, pls. 3, 4.
43. COLE, W. STORRS, Orbitoids from near Duncan Church, Washington County,

Florida (Abstract): *Geol. Soc. America, Proc. for 1933, p. 351* (June, 1934).

44. COLE, W. STORRS, and PONTON, G. M., New species of *Fabularia, Asterocyclina,* and *Lepidocyclina* from the Florida Eocene: *Am. Midland Naturalist,* vol. 15, pp. 138–147, pls. 1, 2.
45. COLLET, LÉON W., Sur une brèche nummulitique à faciès Wildflysch de l'Ile d'Elbe: *Soc. phys. et histoire nat. Genève, Compte rendu,* vol. 51, pp. 95–98.
46. COLLET, LÉON-W., and PARÉJAS, ED., Sur la présence de Crétacé supérieur dans une nappe alpine de l'Ile d'Elbe: *Soc. phys. et. histoire nat. Genève, Compte rendu,* vol. 51, pp. 91–94.

COLLINS, A. C., *see* CHAPMAN, F., PARR, W. J., and COLLINS, A. C.,

47. COLOM CASASNOVAS, G., Contribución al conocimiento de las facies lito-paleontológicas del Crétácico de las Balleares y del S. E. de España: *Assoc. Étude Géol. Médit. Occid.,* vol. 3, no. 2, pt. 5, pp. 1–11, pl. 1, 3 text figs.
48. COLOM CASASNOVAS, G., Estudios sobre las Calpionelas: *Soc. española historia nat., Bol.,* vol. 34, pp. 379–388, 2 text figs., pls. 30–32.

COX, L. R., *see* Supplement for the year 1933.

49. COX, L. R., On the occurrence of the marine Oligocene in Palestine: *Geol. Mag.,* vol. 71, no. 842, pp. 337–355, pls. 16–18.
50. COX, L. R., and THOMAS, H. DIGHTON, The Oligocene in northern Syria: *Geol. Mag.,* vol. 71, no. 843, p. 431.

CRESPIN, IRENE, *see* CHAPMAN, F., and CRESPIN, IRENE.

51. CULLISON, JAMES S., A suitable tray for comparative examination of minute opaque objects under the binocular microscope: *Jour. Paleontology,* vol. 8, p. 247.
52. CUSHMAN, J. A., Notes on the genus *Spiroplectoides* and its species: *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 37–44, pl. 6 (part).
53. CUSHMAN, J. A., The generic position of "*Cornuspira cretacea* Reuss": *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 44–47.
54. CUSHMAN, J. A., Notes on the genus *Tretomphalus* with descriptions of some new species and a new genus, *Pyropilus: Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 79–101, pls. 11, 12, 13 (part).
55. CUSHMAN, J. A., The relationships of *Ungulatella,* with description of additional species: *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 101–104, pl. 13 (part).
56. CUSHMAN, J. A., A recent *Gumbelitria* (?) from the Pacific: *Cushman Lab. Foram. Research, Contr.,* vol. 10, p. 105, pl. 13, figs. 9, 10.
57. CUSHMAN, J. A., Paleozoic foraminifera, their relationships to modern faunas and to their environment (Abstract): *Geol. Soc. America, Proc. for 1933,* p. 364 June, 1934).
58. CUSHMAN, J. A., Smaller foraminifera from Vitilevu, Fiji: *B. P. Bishop Mus., Bull.* 119, pp. 102–142, pls. 10–18.
59. CUSHMAN, J. A., and CAMPBELL, ARTHUR S., A new *Spiroplectoides* from the Cretaceous of California: *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 70, 71, pl. 9.
60. CUSHMAN, J. A., and DUSENBURY, A. N., JR., Eocene foraminifera from the Poway conglomerate of California: *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 51–61, pls. 7–9.
61. CUSHMAN, J. A., and GALLIHER, E. W., Additional foraminifera from the Miocene of California: *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 24–26, pl. 4.
62. CUSHMAN, J. A., and GARRETT, J. B., JR, New species of *Triloculina* from the Claiborne of Louisiana: *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 65–70, pl. 9.
63. CUSHMAN, J. A., and JARVIS, P. W., Some interesting new uniserial foraminifera from Trinidad: *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 71–75, pl. 10.
64. CUSHMAN, J. A., and KLEINPELL, R. M., New and unrecorded foraminifera from the California Miocene: *Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 1–23, pls. 1–4.
65. CUSHMAN, J. A., and PARKER, F. L., Notes on some of the earlier species originally described as *Bulimina: Cushman Lab. Foram. Research, Contr.,* vol. 10, pp. 27–36, pls. 5, 6 (part).
66. CUVILLIER, JEAN, Répartition et valeur stratigraphique de *Nummulites laevigatus* Brug. sp. dans l'Éocène égyptien: *Acad. sci. Paris, Comptes rendus,* vol. 198, pp. 762, 763.
67. CUVILLIER, JEAN, Les Kurkurstufe dans le désert lybique et leur position stratigraphique: *Acad. sci. Paris, Comptes rendus,* vol. 199, pp. 1323–1235.
68. CUVILLIER, JEAN, Sur la présence de *Nummulites discorbina* Schlotheim var. *libyca* Checchia-Rispoli dans les couches terminales du Gebel Galamoun (Oasis de Mouellah): *Soc. géol. France, Compte rendu,* fasc. 2, pp. 18, 19.
69. CUVILLIER, JEAN, Un niveau très fossilifère à la base de l'Éocène supérieur, au sud de la Pyramide de Menkara: *Soc. géol. France, Bull.,* (5), vol. 4, pp. 61–67, 2 text figs.

70. CUVILLIER, JEAN, Introduction géologique (to: JOLEAUD, L., *Kemtichthys sadeki*, nouveau percoïde fossile d'Égypte): *Inst. Égypte, Bull.*, vol. 16, pp. 93, 94.
71. CUVILLIER, JEAN, Les "Esna Shales" et leur veritable signification stratigraphique: *Inst. Égypte, Bull.*, vol. 16, pp. 133–137, 1 pl.
72. CUVILLIER, JEAN, Du Caire à l'Oasis de Farafra via Baharia. Aperçus géographique et géologique: *Soc. Roy. géol. Égypte, Bull.*, vol. 18, pp. 257–281.

73. DAINELLI, G., La serie dei terreni: *Spediz. de Filippi nell' Himalaia*, (2), vol. 2, pp. 1–458, 42 text figs., Bologna.
DARDER I PERICAS, B., *see* Supplement for the year 1933.
74. DAVID-SYLVAIN, ELISABETH, Sur les grands foraminifères du synclinal de Visso (Apennin central): *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 1717, 1718.
75. DAVIES, A. MORLEY, Tertiary faunas; A text-book for oil-field paleontologists and students of geology. Vol. II, The sequence of Tertiary faunas, pp. 1–252, 1 pl., 28 text figs, London, Thomas Murby.
Deecke, W., *see* Supplement for the year 1933.
76. DEFLANDRE, G., Les foraminifères siliceux et le genre *Silicotextulina* Defl. (description et affinités): *Annales Protistol.*, vol. 4, pp. 109–120, 9 text figs. *Non vidi.*
77. DEFLANDRE, G., Sur un foraminifère siliceux fossile des diatomites miocènes de Californie; *Silicotextulina diatomitarum: Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 1446–1448.
78. DELEAU, P., Observations sur la chaîne numidique; le Dj. Mcid Aïcha, le Kef Sema, au sud d'El Milia: *Soc. géol. France, Compte rendu*, pp. 134–136.
79. DESIO, A., and MIGLIORINI, C. I., Il XLVI Congresso della Società Geologica Italiana. Cenni geologici per la escursioni: *Soc. geol. italiana, Bull.*, vol. 52, fasc. 2, pp. 37–87, 1 text fig.
80. DEUSSEN, ALEXANDER, Oil-producing horizons of Gulf Coast in Texas and Louisiana: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, pp. 500–518, 10 text figs.
81. DIETRICH, W. O., Professor Dr. Paul Oppenheim, 28. V. 1863– 19. I. 1934: *Centralbl. Mineralogie*, Abt. B., pp. 286–288.
82. DONCIEUX, L., PAVANS DE CECCATTY, R., and SOLIGNAC, M., Sur la présence de fragments de calcaire nummulitique dans certains cailloutis quaternaires de la région de Médenine (Extrême-Sud Tunisien): *Acad. sci. Paris, Comptes rendus*, vol. 199, pp. 78–80.
DOUTKEVITCH, G. A., *see* Supplement for the year 1932.
83. DOUTKEVITCH, G. A., Permian fauna of Fusulinidae found in the sections of Kara-su and Kuberganda in East Pamir: *Tadjiik Complex Exped. of 1932, Pub., Geology of Pamir, Acad. Sci. U. S. S. R.* vol. 8, pp. 53–104, pls. 1–3 (in Russian). *Non vidi.*
84. DOUTKEVITCH, G. A., Some new species of Fusulinidae from the Upper and Middle Carboniferous of Verkhne-Chussovskye Gorodki on the Chussovaya River (western slope of the Middle Urals): *Petroleum Prosp. Geol. Inst., Pub., Trans. Oil Geol. Inst.*, ser. A, vol. 36, pp. 1–98, pls. 1–6. (Russian text pp. 1–57, English summary pp. 58–98.) *Non vidi.*
85. DOUTKEVITCH, G. A., and KHABAKOV, A. V., Piérmskié otlojénia vostotchnogo pamira i paléogéografia vierkniégo paléozoia stchiéntralbnoi azii: *Akad. Nauk Soiouza Sovietsk Sozialist*, vol. 8, pp. 1–122, 13 text figs., pls. 1–3. *Non vidi.*
86. DOUVILLÉ, HENRI, Les Fusulinidés de la Tunisie. In, SOLIGNAC, M., Le Permien marin de l'extrême sud tunisien. *Services carte géol. Tunisie, Mém.*, new ser., no. 1, pp. 75–90, pls. 1–3.
DOZY, J. J., *see* VLERK, I. M. VAN DER, and DOZY, J. J.
87. DUBERTRET, L., Présentation d'une carte géologique générale au 1: 1 000 000e de la Syrie et du Liban: *Rev. géog. géol. dynamique*, vol. 6, no. 4.
88. DUNBAR, CARL O., and HENBEST, L. G., Comparative anatomy and evolutionary trends of Pennsylvanian Fusulinidae (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 352, June 1934.
DUSENBURY, A. N., JR., *see* CUSHMAN, J. A., and DUSENBURY, A. N., JR.

89. EARLAND, ARTHUR, Foraminifera. Part III. The Falklands sector of the Antartic (excluding South Georgia): *Discovery Repts.*, vol. 10, pp. 1–208, pls. 1–10, 2 text figs.
90. EICHENBERG, W., Die Erforschung der Mikroorganismen, insbesondere der Foraminiferen der norddeutschen Erdölfelder. Teil I; Die Foraminiferen der Unterkreide. 3. Folge; Foraminiferen aus dem Hauterive von Wenden am Mittellandkanal: *Niedersächs. Geol. Ver. Hannover, Jahresber.* 26, pp. 149–196, pls. 10–17.
91. EICHENBERG, W., Mikrofaunen-Vergesellschaftung und Erdölbohrkern-Bestimmung: *Deutsche geol. Gesell., Zeitschr.*, vol. 86, pp. 491, 492.
92. ELLISOR, ALVA C., and TEAGLE, JOHN, Correlation of Pecan Gap chalk in Texas: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, pp. 1506–1536, 4 text figs.

EMELJANTZEV, TICHON, *see* FREDERICKS, G., and EMELJANTZEV, TICHON.

93. EUGSTER, H., Weissbad-Fähneren: *Geol. Führer Schweiz*, fasc. 12, pp. 885–888, 2 text figs.

94. FICHTER, H. J., Geologie der Bauen-Brisen-Kette am Vierwaldstättersee und die zyklische Gliederung der Kreide und des Malm der helvetischen Decken: *Geol. Karte Schweiz, Beitr.*, n.f., vol. 69, pp. 1–128, 19 text figs. 3 pls. (sections).

95. FLANDRIN, J., La faune de Tizi Renif, près Dra El Mizan (Algérie): *Soc. géol. France, Compte rendu*, p. 84, 19 mars.

96. FLANDRIN, J., La faune de Tizi Renif, près Dra el Mizan (Algérie): *Soc. géol. France, Bull.*, (5), vol. 4, pp. 251–272, pls. 14–16, 7 text figs.

97. FLANDRIN, J., and LUCAS, G., Sur l'age des dépôts à faciès Medjanien du Djebel Morissane (Département de Constantine): *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 1937–1939.

98. FLORIDIA, G. B., Sull'eta dei calcari a *Chlamys cirenaica* (Newton) dei dintorni di Derna: *Inst. Lombardo Sci. Letters, Rend.*, vol. 67, fasc. 11–15, pp. 1–5, 2 text figs.

99. FLORIDIA, G. B., Sopra alcune rocce nummulitiche del Gebel Cirenaico: *R. accad. d'Italia*, Febbraio, 1934; reprint, 11 pp., 1 text fig.

100. FOURMARIER, P., Vue d'ensemble sur la géologie de la Belgique. Ses enseignements dans la domaine de la géologie générale: *Soc. géol. Belgique, Annales, Mém.*-in 4°, pp. 1–200, 50 text figs., 5 pls.

101. FREDERICKS, GEORGE, Uralian and Permian of the Urals: *Geol. Soc. China, Bull.*, vol. 13, pp. 505–561, 2 tables.

102. FREDERICKS, GEORGE, and EMELJANTZEV, TICHON, Über das Alter der *Cora*- und *Omphalotrochus*-Schichten des "Oberkarbons" am Ural: *Centralbl. Mineralogie*, Abt. B., pp. 15–18.

103. FROMAGET, JACQUES, Observations et réflexions sur la géologie stratigraphique et structurale de l'Indochine: *Soc. géol. France, Bull.*, (5), vol. 4, pp. 101–164, 11 text figs., pls. 7, 8.

104. FROMAGET, JACQUES, Note au sujet de la classification du Permien à Fusulinidés: *Soc. géol. France, Bull.*, (5), vol. 4, pp. 385–388, 2 tables.

105. FURON, RAYMOND, Sur la géologie de l'Hindou-Kouch et du Pamir: *Soc. géol. France, Bull.*, (5), vol. 4, pp. 69–78, 1 text fig.

106. GAGNEBIN, ÉLIE, Les Préalpes et les "Klippes": *Geol. Führer Schweiz*, fasc, 2. pp. 79–95, 1 text fig.

GALLIHER, E. W., *see* CUSHMAN, J. A., and GALLIHER, E. W.

GALLOWAY, JOHN, *see* BARBAT, W. F., and GALLOWAY, JOHN.

GARRETT, J. B., JR., *see* CUSHMAN, J. A., and GARRETT, J. B., JR.

107. GERASIMOV, N., Nekotoryne zamechanya k state Prof. M. E. Noinskogo "Schwagerinovyi gorizont i artinskie otlozheniya na Yuzhnom Urale" (Some remarks on the article of Prof. M. E. Noinskii "*Schwagerina* horizon and Artinsk deposits of the southern Urals): *Kazan Univ., Uchenyi Zapiski*, vol. 94, no. 1, pp. 28–67. (Russian with German summary on pp. 66, 67.) *Non vidi.*

108. GETZENDANER, A. E., McFaddin-O'Conner, Greta, Fox, Refugio, White Point, and Saxet fields, Texas.: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, pp. 519–530, 4 text figs.

109. GIGNOUX, MAURICE, and MORET, LÉON, Stratigraphie de la bordure externe de la zone du flysch de l'Embrunais, entre la Durance et le Drac (Massifs de Piolit et des Autanes, Hautes-Alpes): *Acad. sci. Paris., Comptes rendus*, vol. 199, pp. 1081–1083.

110. GOČEV, P., Geologische Notizen über die Umgebung der Seen von Varna: *Bulgarische geol. Gesell., Zeitschr.*, vol. 6, pp. 31–65, 2 pls., 1 text fig. (Bulgarian with German summary.)

111. GÖTZINGER, GUSTAV, Eine neue Klippe in Flysch W. der Traisen. Die tektonische Linie von Rabenstein an der Pielach: *Geol. Bundesanstalt., Wien, Verh.*, pp. 86–88.

112. GÖTZINGER, GUSTAV, and BECKER, H., Neue geologisch-stratigraphische Untersuchungen im Flysch des Wienerwaldes: *Akad. Wiss. Wien, Math.-naturwiss. Kl.*, Anz. no. 3, reprint, 6 pp.

113. GOUDKOFF, Paul, P. Subsurface stratigraphy of Kettleman Hills Oil field, California: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, pp. 435–475, 8 text figs.

114. GRAVELL, DONALD W., and HANNA, MARCUS A., Larger foraminifera from the Moody Branch marl, Jackson Eocene, of Texas, Louisiana and Mississippi (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 367, June, 1934.

GRIFFIN, FRANCIS J., *see* SHERBORN, C. D., and GRIFFIN, Francis J.

115. GRÖNWALL, KARL A., Wilhelm Deecke: *Geol. fören. Stockholm, Förh.* vol., 56, no. 399, pp. 619, 620.

116. GUBLER, J., A propos de *Doliolina neoschwagerinoides* Deprat: *Soc. géol. France Compte rendu*, pp. 252–254, Dec. 17.

117. GUBLER, J., A propos de la classification du Permien à Fusulinidés: *Soc. géol. France, Bull.*, (5) vol. 4, pp. 443–448, 1 table.

118. GUBLER, J., La valeur stratigraphique

des Fusulinidés du Permien: *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 381–383.

119. GUBLER, J., Structure et secrétion du test des Fusulinidés: *Archives de Protistologie, Paris*, vol. 4, pp. 1–24, 15 text figs.
120. GUNZLER-SEIFFERT, Hans, Geologischer Atlas der Schweiz, 1: 25 000. Blatt 395; Lauterbrunnen und nördliches Randgebiet von Blatt 488, Blümlisalp. Erläuterungen: *Geol. Kommission Schweiz. Naturf. Gesell.*, 6 pp.
121. HADLEY, WADE, H., JR., Some Tertiary foraminifera from the north coast of Cuba: *Bull. Am. Paleontology*, vol. 20, no. 70 A, pp. 1–40, pls. 1–5.
HANNA, MARCUS A., *see* GRAVELL, D. W., and HANNA, M. A.
122. HARLTON, BRUCE H., Carboniferous stratigraphy of the Ouachitas with special study of the Bendian: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, pp. 1018–1049, 8 text figs.
123. HAZZARD, ROY T., BLAINPIED, B. W. et al., *Shreveport Geol. Soc., Guidebook*, 11th *ann. field trip*, 50 maps, charts, 6 fossil plates. *Non vidi.*
124. HECHT, FRANZ, Einfache Geräte zum Fotografieren von Mikrofossilien, insbesondere Foraminiferen: *Senckenbergiana*, vol. 16, pp. 65–77, 11 text figs.
125. HECHT, FRANZ, Eine neue Verteilungszelle zum Aufbewahren von Mikrofossilien, vornehmlich Foraminiferen: *Senckenbergiana*, vol. 16, pp. 152–155, 2 text figs.
126. HEDBERG, HOLLIS D., Some Recent and fossil brackish to fresh-water foraminifera: *Jour. Paleontology*, vol. 8, pp. 469–476, 1 text fig.
127. HEIM, ARNOLD, Walensee (Amden-Mattstock-Churfirsten): *Geol. Führer Schweiz*, fasc. 12, pp. 924–930, 3 text figs.
128. HENBEST, LLOYD. A new term for the youthful stage of foraminiferal shells: *Science*, vol. 79, no. 2051, pp. 363, 364.
129. HENBEST, LLOYD, Keriothecal wall structure in *Fusulina;* its significance and resolution by selective stains (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 353, June, 1934.
130. HENBEST, LLOYD G., Danger of inhaling the vapor of carbon tetrachloride: *Jour. Paleontology*, vol. 8, p. 480.
HENBEST, LLOYD G., *see* DUNBAR, C. O., and HENBEST, L. G.
131. HENRICI, HEINZ, Foraminiferen aus dem Eozän und Altmiozän von Timor: J. WANNER, *Beitr. geol. Nederland-Indien, Supp.*, vol. 4; *Palaeontographica, Supp.*, Band 4, pp. 1–56, 4 pls., 26 text figs., tables.
132. HENTSCHEL, E., Allgemeine Biologie des südatlantischen Ozeans. 1. Lieferung; Das Pelagial der obersten Wasserschicht.: *Deutsche Atlantische Expedition*, 1925–27, *Wiss. Ergebn.*, vol. 11, 67 text figs., 8 enclosures.
133. HERITSCH, FRANZ, Die Stratigraphie von Oberkarbon und Perm in den Karnischen Alpen: *Geol. Gesell. Wien, Mitt.*, vol. 26, pp. 180–189, table 2.
134. HERITSCH, FRANZ, Die oberpermische Fauna von Žažar und Vrzdenec in den Savefalten: *Geol. Inst. Kralj. Jugoslavia, Vesn.*, vol. 3, no. 1, pp. 6–61, 10 text figs., 2 pls.
135. HERITSCH, FRANZ, KAHLER, FRANZ, and METZ, KARL, Die Schichtenfolge von Oberkarbon und Unterperm: *Geol. Gesell. Wien, Mitt.*, vol. 26, pp. 163–180, table 1.
136. HERON-ALLEN, E., Proliferating nomenclature of foraminifera: *Nature*, vol. 134, no. 3376, pp. 43–45.
137. HICKSON, SYDNEY J., On *Gypsina plana*, and on the systematic position of the stromatoporoids: *Micr. Sci., Quart. Jour.*, vol. 76, pt. 3, pp. 433–480, pls. 26, 27, 13 text figs.
138. HOARE, CECIL A., and BARGMANN, H. E., Zoological Record II; Protozoa: *Zool. Soc. London, Zool. Rec.*, vol. 70, pp. 1–72.
139. HOFFET, JOSUÉ, Sur la présence du Permien inférieur dans le Haut-Laos occidental: *Acad. sci. Paris, Comptes rendus*, vol. 199, pp. 1237–1239.
HOLLISTER, J. S., *see* ASHAUER, H., and HOLLISTER, J. S.
140. HOJNOS, R., Verslag over een micropalaeontologisch onderzoek van sedimentaire gesteenten iut Celebes: *Geol.-mijnb. genootsch. Nederland en Kolonien, Verh.*, Geol. ser. 10, pp. 291–294.
HOWCHIN, W., *see* CHAPMAN, F., HOWCHIN, W., and PARR, W. J.
141. HOWE, HENRY V., *Bitubulogenerina*, a Tertiary new genus of foraminifera: *Jour. Paleontology*, vol. 8, pp. 417–421, pl. 51, 1 text fig.
142. HOWE, HENRY V., and WALLACE, W. E., Apertural characteristics of the genus *Hantkenina*, with description of a new species: *Jour. Paleontology*, vol. 8, pp. 35–37, pl. 5, figs. 13–17.
143. HOWE, HENRY V., and WALLACE, W. E., Apertural characteristics of the genus *Hantkenina*, with the description of a new species (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 371, June, 1934.
144. HUGUES, JOSÉ BALTA, Estratigrafia de Lobitos y el alto y su relacion con la microfauna local: *Soc. Geol. Peru, Bol.*, vol. 6, fasc. 3, pp. 1–25. *Non vidi.*

145. IMAMURA, S., On the Yatuo Tertiary, with special reference on the distribution of foraminifera (in Japanese): *Geol. Soc. Tokyo, Jour., 1932*, vol. 39, no. 465. *Non vidi.*
ISHIJIMA, W., *see* Supplement for the year 1933.

JARVIS, P. W., *see* CUSHMAN, J. A., and JARVIS, P. W.

146. JAWORSKI, E., Neue Literatur. (b) Palaontologisch: *Zeitschr. Indukt. Abstammungs-u. Vererbungslehre*, Band 67, Hefte 3–4, pp. (1)–(96). Foraminifera, pp. (23)–(29).
147. JEANNET, A., and BUCK, DAMIAN, Observations stratigraphiques dans le Nummulitique dit d'Einsiedeln: *Eclogae geol. Helvetiae*, vol. 27, pp. 370–372.
148. JEANNET, A., and BUCK, DAMIAN, Observations stratigraphiques dans le Nummulitique dit d'Einsiedeln: *Schweizer. naturf. Gesell., Verh.*, pp. 319–321.
149. JEDLITSCHKA, HEINRICK, Ein Profil durch die jüngeren Überlagerungen des Karbons in Orlau und seine Fauna: *Naturf. Ver. Brünn, Verh.*, 65 Jahrg., pp. 1–16, 4 text figs.
150. JEDLITSCHKA, HEINRICH, Über *Candorbulina*, eine neue Foraminiferen-Gattung und zwei neue *Candeina*-Arten: *Naturf. Ver. Brünn, Verh.*, 65 Jahrg., pp. 17–26, 23 text figs.
151. JEKELIUS, ERICH, Die nördlichen Vorgebirge des Törcsvárer Passes: *Ungar. geol. Anst., Jahresber.* 1917–1924, pp. 237–239.
JOHNSON, F. L., *see* BARBAT, W. F., and JOHNSON, F. L.
152. JOLEAUD, LEONCE, Paul Lemoine: *Assoc. franç. av. sci., Bull.*, vol. 63, no. 118, pp. 9–11.
153. JUNG, J., Sur la position des tufs rhyolithiques viséens de la vallée de la Sioule (Puy-de-Dôme) et l'age antéhercynien des gneiss et des granites de la partie nord-ouest du Plateau Central: *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 2269, 2270.
154. KAHLER, FRANZ, Über das Vorkommen der Fusuliniden im Karbon und Perm der Karnischen Alpen: *Akad. Wiss. Wien, Math.-naturwiss. Kl., Anz.*, no. 18, pp. 233–235.
155. KAHLER, FRANZ, Ein Vergleich der amerikanischen und karnischen Stratigraphie des Karbons und Perms mit Hilfe der Fusulinengattungen: *Akad. Wiss. Wien, Math.-naturwiss. Kl., Anz.*, no. 18, pp. 235–237.
KAHLER, FRANZ, *see* HERITSCH, F., KAHLER, F., and METZ, KARL.
KENNY, E. J. ANDRE, *see* MACFADYEN, W. A., and KENNY, E. J. ANDRE.
KHABAKOV, A. V. (Chabakov), *see* DOUTKEVITCH, G. A., and KHABAKOV, A. V.
156. KING, PHILIP B., Permian stratigraphy of Trans-Pecos Texas: *Geol. Soc. America, Bull.*, vol. 45, pp. 697–798, pls. 103–107, 13 text figs.
157. KING, R. E., The Permian of southwestern Coahuila, Mexico: *Am. Jour. Sci.*, vol. 27, pp. 98–112, 4 text figs.
158. KING, R. E., Geological reconnaissance of central Sonora: *Am. Jour. Sci.*, vol. 28, pp. 81–101, 3 maps, 1 section.
159. KJELLESVIG, ERIK N., Trenton foraminifera from New York (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 340, June, 1934.
160. KLEINPELL, R. M., Difficulty of using cartographic terminology in historical geology: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, pp. 374–379.
161. KLEINPELL, ROBERT M., Note regarding the correlation of the Temblor and Vaqueros: In PACKARD, E. L., and KELLOGG, REMINGTON, A new Cetothera from the Miocene Astoria formation of Newport, Oregon: *Carnegie Inst. Washington, Pub.* 447, p. 24.
KLEINPELL, R. M., *see* CUSHMAN, J. A., and KLEINPELL, R. M.
162. KLEINPELL, ROBERT M., Proposed biostratigraphic classification of California Miocene (Abstract): *Geol. Soc. America, Cordilleran Sec., List of papers with abstracts, 33d Ann. Meeting*, p. 46, Berkeley, 1934.
163. KLEINPELL, ROBERT M., Miocene foraminifera from Contra Costa County, California (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 390, June, 1934.
164. KOCH, FERDO, Geologija otoka Visa. (Zur Geologie der Insel Vis-Lissa): *Geol. Inst. Kraljev. Jugoslavia Povrem izdanja.*, p. 10.
165. KOFOID, C. A., An interpretation of the conflicting views as to the life cycle of foraminifera: *Science*, vol. 79, no. 2054, p. 436.
166. KRENKEL, E., Geologie Afrikas. III. Teil, 1. Hälfte: *Geol. d. Erde*, Borntraeger, Berlin, pp. viii, 1003–1304, 2 pls., 50 text figs.
167. KRUMBECK, L., Die Aucellen des Malms von Misol: *Neues Jahrb., Beilage-Band* 71, Abt. B., pp. 422–467, pls. 14–16.
168. KÜHN, OTHMAR, Ein Eozänvorkommen auf Chalkidike: *Centralbl. Mineralogie*, Abt. B., pp. 125–136, 165–177, 2 text figs.
169. KULCSÁR, KÁLMÁN, Die geologischen Verhältnisse des Gebietes zwischen Tóthalom, Illava, Viszolaj und Egyházasnádas: *Ungar. geol. Anst., Jahresber.* 1917–1934, pp. 275–283.

170. LACOSTE, JEAN, Etudes géologiques dans le Rif méridional. Tome I: Stratigraphie, Sedimentation-Paléogeographie.: *Service Mines Carte géol. Maroc, Notes et Mém.*, 463 pp., figs., plates. (Vol. 2 deals with tectonics.)
171. LADD, HARRY S., Geology of Vitilevu, FIJI: *B. P. Bishop Mus., Bull.* 119, pp. 1–101, 9 text figs., 1 map.
172. LAFFITTE, ROBERT, Sur la présence de l'Albien dans l'Aurès (Algérie): *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 191–193.
173. LAPPARENT, ALBERT F. DE, Le Nummulitique de Saint-Vallier-de-Thiey (Alpes Maritimes): *Soc. géol. France, Compte rendu*, vol. 198, p. 79.
174. LAPPARENT, ALBERT F. DE, Le Nummulitique de Saint-Vallier-de-Thiey (Alpes Maritimes): *Soc. géol. France, Bull.*, (5), vol. 4, pp. 79–83.
175. LAPPARENT, JACQUES DE, Gisement et position géologiques des bauxites de Grèce: *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 1162–1164.
176. LAPPARENT, JACQUES DE, Developpement des calcaires à Rosalines en Grèce: *Acad. sci. Paris, Comptes rendus*, vol. 198, pp. 1620–1622.
177. LE CALVEZ, JEAN, Embryons à cinq loges de *Planorbulina mediterranensis* (d'Orb.) et trimorphisme de cette espèce: *Soc. zool. France, Bull.*, vol. 59, pp. 284–290, 4 text figs.
178. LEE, Y. Y., Note on the Meitien limestone, an Upper Permian formation in the Nanling range: *Geol. Soc. China, Bull.*, vol. 13, pp. 233–236, 2 text figs.
179. LEE, Y. Y., and CHU, S., Geology of Kenkou on the Hunan-Kwangtung border and its bearing on the orogeny of the Nanling ranges: *Geol. Soc. China, Bull.*, vol. 13, pp. 183–196, 2 text figs., 1 map.
180. LI, C., and CHU, S., Note on the stratigraphy of the environs of the Maping City, Central Kwangsi (with special reference to the "Maping limestone"): *Geol. Soc. China, Bull.*, vol. 13, pp. 215–232, 4 text figs.
181. LICHAREW, BORIS, The Upper Carboniferous of Fergana and the question of the boundary between the Carboniferous and the Permian: *Geol. Soc. China, Bull.*, vol. 13, pp. 155–182.
182. LICHAREW, BORIS, Zur Frage über das Alter des Kalksteines von Safet-Daron in Darwas: *Acad. Sci. U. R. S. S., Comptes rendus*, pp. 180–184. (Russian with German summary, pp. 182–184.)
183. LIEBUS, ADALBERT, Neue Foraminiferenfunde aus dem Wienerwald-Flysch: *Geol. Bundesanstalt, Wien, Verh.*, no. 6–9, pp. 65–70, 6 text figs.
184. LIJN, P. VAN DER, Nieuwe en zeldzame zwerfsteenen III.: *Natura*, no. 432, pp. 201–205, 2 photographs.
185. LIPPARINI, TINO, Fossili del Miocene medio di Fabriano (Marche): *R. ufficio geol. Italia, Boll.*, vol. 59, no. 5, pp. 1–10, pl. 1.
LIZAUR, J. DE, *see* MARIN, A., PASTORA, J. L., and LIZAUR, J. DE.
186. LOCZY, L. VON, Geologie van Noord Boengkoe an het Bongka-Gebied tusschen de Golf van Tomini en de Golf van Tolo, in Oost-Celebes: *Geol.-mijnb. genootsch. Nederland en Kolonien, Verh.*, Geol. ser. 10, no. 3, pp. 219–276, 2 text figs., 2 pls., 1 geol. map.
LUCAS, G., *see* FLANDRIN, J., and LUCAS, G.
187. LUCKE, JOHN B., A study of Barnegat Inlet, New Jersey, and related shoreline phenomena: *Shore and Beach*, vol. 2, no. 2, pp. 5–54.
188. LUGEON, M., Lenk-Rawyl-Plaine Morte-Sierre: *Geol. Führer Schweiz*, fasc. 6, pp. 444–449, 2 text figs.
189. LUGEON, M., Environs de Bex-Dent de Morcles: *Geol. Führer Schweiz*, fasc. 6, pp. 436–443, 1 text fig.
MABUTI, S., *see* YABE, H., and MABUTI, S.
190. MACFADYEN, W. A., On the marine gravels at March, Cambridgeshire: *Geol. Mag.*, vol. 71, no. 842, p. 384.
191. MACFADYEN, W. A., and KENNY, E. J. ANDRE, On the correct writing in form and gender of the names of the foraminifera: *Roy. Micr. Soc., Jour.*, (3), vol. 54, pp. 177–181.
192. MACOVEI, G., and ATANASIU, I., l'évolution de la Roumanie. Crétacé: *Inst. geol. Românie, Anuarul*, vol. 16 (1931), pp. 63–280, 47 text figs., 10 pls, 1934.
193. MARCHETTI, MARCO, Nota illustrative per un abbozzo di carta geologica della Cirenaica: *Soc. geol. italiana, Boll.*, vol. 53, pp. 309–325, pl. 17.
194. MARIN, A., PASTORA, J. L., and LIZAUR, J. DE, Premières recherches de pétrole sur la côte atlantique du territoire du Protectorat Espagnol au Maroc: *Soc. géol. France, Bull.*, (5), vol. 4, pp. 649–673, 21 text figs., pls. 32, 33, 1934 (published October, 1935).
195. MARIN, AUGUSTIN, and others, Iniciación de las investigaciones petrolíferas en la costa atlantica de la zona del protectorado español de Marruecos: *Rev. minera*, vol. 85, no. 3416, pp. 317–319; no. 3417, pp. 329–331; no. 3420, pp. 365–368; no. 3421, pp. 377–379; 6 figs
196. MEFFERT, B., Geological sketch of the region of the projected powerful hydro-electrostation of Georgia in the Ingut, Tskhenistskali, Rion and Kura basins:

United Geol. Prosp. Service, U. S. S. R., Trans., no. 349, pp. 1–45, 1 map. (Russian with English summary.) *Non vidi.*

METZ, KARL, *see* HERITSCH, F., KAHLER, F., and METZ, K.

MIGLIORINI, C. I., *see* DESIO, A., and MIGLIORINI, C. I.

197. MIRTOVA, AL., Occurrence of a foraminiferal fauna (Tertiary) in the brackish-water facies of the akchagyls of the Kazan-Transkahna region: *Kazan Univ., Uchenyi Zapiski*, vol. 94, k. 1, Geol. vyp. 3, pp. 183–188, 1 pl. (Russian text, pp. 183–187; summary in English, p. 188.) *Non vidi.*

MISRA, M. L., *see* NATH, RAJ, and MISRA, M. L.

198. MONSEN, ASTRID, Meddelelser om nogen skjellforekomster fra Nordre Helgeland: *Bergens Mus., Arbok* No. 7, pp. 1–18. (Norwegian with German summary.)

199. MOORE, RAYMOND C., and MOSS, R. G., Permian-Pennsylvanian boundary in the northern Mid-Continent area (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 100, June, 1934.

200. MORELLET, L., Découverte de *Nummulites laevigatus* (Lk.) sur la plage de Wimereux (Pas-de-Calais): *Soc. géol. France, Compte rendu*, p. 228, 3 decembre.

201. MORELLET, L. and J., Le Bartonien de Hadancourt-le-Haut-Clocher (Oise): *Mus. nat. histoire nat., Bull.*, (2), vol. 6, pp. 147–149.

MORET, LEON, *see* GIGNOUX, MAURICE, and MORET, LEON.

202. MORROW, A. L., Foraminifera and Ostracoda from the Upper Cretaceous of Kansas: *Jour. Paleontology*, vol. 8, pp. 186–205, pls. 29–31.

MOSS, R. G., *see* MOORE, RAYMOND C., and MOSS, R. G.

203. MUHEIM, FRANZ, Die subalpine Molassezone im östlichen Vorarlberg: *Eclogae geol. Helvetiae*, vol. 27, pp. 181–296, pls. 6, 7, 1 text fig.

204. MURGEANU, G., La nappe interne du Flysch dans les environs de Comarnic et de Teşila (Prahova): *Inst. geol. României, Anuarul*, vol. 16, pp. 281–326, 5 text figs., 1 pl. (geol. map).

205. MUSPER, K. A. F. R., Nieuwe fossielresten en de ouderdom kalksteenen in het Pretertiair van het Goemai-gebergte: *De Ingenieur in Ned.-Indie*, vol. 1, no. 8, pp. IV.134–IV.142, 7 text figs., 1 pl.

206. MYERS, EARL H., The life history of *Patellina corrugata*, a foraminifer: *Science*, vol. 79, no. 2054, pp. 436, 437.

207. NAGAO, TAKUMI, New localities of *Orbitolina* limestone in Hokkaido: *Geol. Soc. Tokyo, Jour.*, vol. 41, no. 468, pp. 150, 151.

208. NALIWKIN, D., Die wichtigsten Ergebnisse der geologischen Untersuchungen im Pamir: *Tadschikische Komplex-Expedition 1932, Akad. Wiss. Leningrad, 1933*, pp. 71–74 (Russian).

209. NATH, RAJ, and MISRA, M. L., Paleontological study of *Nummulites* from the Laki dome and the hills near Bagatora, Sind: *Asiatic Soc. Bengal, Proc. 21st Indian Sci. Cong., Abstracts*, p. 350.

210. NATLAND, MANLEY L., Distribution of some Recent and fossil foraminifera in the southern California region (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 393, June, 1934.

211. NEGRI, G., Contribuzione alla conoscenza del paleogene del Gebel Cirenaico: *Soc. italiana sci. nat., Atti*, vol. 73, fasc. 3, pp. 237–253.

212. NEVIANI, A., Appunti per una storia sugli studi intorno ai minuti foraminiferi dalle origini ai tempi di Giovanni Bianchi: *Soc. geol. italiana, Boll.*, vol. 53, pp. 91–93.

213. NEWELL, NORMAN D., Some Mid-Pennsylvanian invertebrates from Kansas and Oklahoma; I. Fusulinidae, Brachiopoda: *Jour. Paleontology*, vol. 8, pp. 422–432, pls. 52–55.

214. NOINSKII, M. E., Shvagerinovyi gorizont; Artinske otlozheniya na Yuzhnam Urale (*Schwagerina* horizon and Artinsk deposits in the southern Urals): *Kazan Univ., Uchenyi Zapiski*, vol. 94, no. 1, Geol. no. 3, pp. 15–27 (Russian).

215. NOSKY, J., Adatok az északi Bakony krétaképzöd-ményeinek ismeretéhez (Beiträge zur Kenntnis der kretazischen Bildungen des nördlichen Bakony): *Földtani Közlöny*, vol. 64, pp. 99–136, 1 text fig.

216. OBERHOLZER, J., Schild und Mürtschenstock: *Geol. Führer Schweiz*, fasc. 12, pp. 918–923, 1 text fig.

217. OBERHOLZER, J., Altdorf-Klausenpass-Linthal-Glarus: *Geol. Führer Schweiz*, fasc. 12, pp. 906–911, 1 text fig.

218. OLSSON, AXEL A., Contributions to the paleontology of northern Peru; the Cretaceous of the Amotape region: *Bull. Am. Paleontology*, vol. 20, no. 69, pp. 1–104, 2 text figs., pls 1–11.

219. OPPL, EGON, Die mikropaläontologische Untersuchung des Salzbohrloches S.2 bei Troppau: *Naturf. Ver. Brünn, Verh.*, vol. 65, pp. 27–66, pls. 1, 2, 2 tables.

220. PALMER, DOROTHY K., The foraminiferal genus *Gümbelina* in the Tertiary of Cuba: *Soc. cubana hist. nat., Mem.*, vol. 8, pp. 73–76, 8 text figs.

221. PALMER, DOROTHY K., Some large fossil foraminifera from Cuba: *Soc. cubana hist. nat., Mem.* vol. 8, pp. 235–264, 19 text figs., pls. 12–16.

222. PALMER, DOROTHY K., The occurrence of fossil *Radiolaria* in Cuba: *Soc. cubana hist. nat., Mem.*, vol. 8, pp. 77–82, 1 text fig.
223. PALMER, DOROTHY K., Upper Cretaceous age of the orbitoidal genus *Gallowayina* Ellis (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 372, June, 1934.
224. PALMER, DOROTHY K., The Upper Cretaceous age of the orbitoidal genus *Gallowayina* Ellis: *Jour. Paleontology*, vol. 8, pp. 68–70.
225. PALMER, ROBERT H., The geology of Habana, Cuba, and vicinity: *Jour. Geology*, vol. 42, pp. 123–145, 6 text figs.
226. PAPP, KARL VON, Die Klippen des Pietruc und Bradisor an der Grenze der Komitate Alsófehér und Hunyad: *Ungar. geol. Anstalt, Jahresber.* 1917–1934, pp. 219–221.
PARÉJAS, ED., *see* COLLET, L. W., and PARÉJAS, ED.
PARKER, F. L., *see* CUSHMAN, J. A., and PARKER, F. L.
227. PARKS, W. A., Systematic position of Stromatoporoidea (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 344, June, 1934.
228. PARR, WALTER J., Tertiary foraminifera from Chalky Island, southwest New Zealand: *Roy. Soc. New Zealand, Trans.*, vol. 64, pp. 140–146, 3 text figs., pl. 20.
PARR, WALTER J., *see* CHAPMAN, F., PARR, W. J., and COLLINS, A. C.
PARR, WALTER J., *see* CHAPMAN, F., HOWCHIN, W., and PARR, W. J.
PASTORA, J. L., *see* MARIN, A., PASTORA, J. L., and LIZAUR, J.
PAVANS DE CECCATTY R., *see* DONCIEUX, L., PAVANS DE CECCATTY R., and SOLIGNAC, M.
229. PAZDROWA, OLGA, Les Nummulines des environs de Dukla: *Kosmos, Lwów*, vol. 59, ser. A., Abh., pp. 263–289, 2 pls. (Polish with French summary.)
PEYER, B., *see* SCHINZ, H. R., and PEYER, B.
230. PFALZ, RICHARD, Die Hauptzüge im geologischen Bau Italienisch-Libyens: *Geol. Rundschau*, vol. 25, pp. 111–134.
231. PFENDER, JULIETTE, A propos du *Siderolites vidali* Douvillé et quelques autres: *Soc. géol. France, Compte rendu*, pp. 79, 80.
232. PFENDER, JULIETTE, Les gisements du Cénomanien à Alvéolines en Basse-Province: *Soc. géol. France, Compte rendu*, pp. 157–158.
233. PFENDER, JULIETTE, A propos du *Siderolites vidali* Douvillé et de quelques autres: *Soc. géol. France, Bull.*, (5), vol. 4, pp. 225–236, 4 text figs., pls. 11–13.
234. PFENDER, JULIETTE, Les gisements du Cénomanien à Alvéolines en Basse-Province: *Soc. géol. France, Bull.*, (5), vol. 4, pp. 461–491, 8 text figs., 2 tables, pl. 24. (Published June, 1935.)
235. PLUMMER, HELEN JEANNE, *Epistominoides* and *Coleites*, new genera of foraminifera: *Am. Midland Naturalist*, vol. 15, pp. 601–608, 1 text fig., pl. 24.
PONTON, GERALD M., *see* COLE, W. STORRS, and PONTON, GERALD M.
236. POTONIÉ, R., Erdöl-Paläontologie: *Geistige Arb.* 1934, no. 4, Berlin und Leipzig, p. 11.
237. POTONIÉ, ROBERT, Mikropaläontologie von Erdöl und Kohle: *Forschung und Fortschr.*, Berlin, vol. 10, p. 296.
238. PRICE, W. ARMSTRONG, Lissie formation and Beaumont clay in south Texas: *Am. Assoc. Petroleum Geologists, Bull.*, vol. 18, pp. 948–959, 4 text figs.
239. PRINCIPI, PAOLO, Relazione al rilevamento geologico del quadrante al 50 000 "Pennabilli" appartenente al folgio 108 della carta d'Italia: *R. ufficio geol. Italia, Boll.*, vol. 59, no. 8, pp. 1–17, 9 text figs.
240. PRINCIPI, PAOLO, Alcune osservazioni sulla analogia esistenti fra i terreni terziari dell'Albania e quelli dell'Italia centrale: *R. accad. Lincei, Cl. sci. fis., mat. e. nat., Rend.* (6), vol. 20, fasc. 5-6, pp. 200–204.
241. PRINCIPI, PAOLO, I terreni terziari nei Monti Sabini meridionali: *Soc. geol. italiana, Boll.*, vol. 53, pp. 239–248.
242. PRINCIPI, PAOLO, I terreni miocenici nella regione di Antrodoco (Abruzzo): *Soc. geol. italiana, Boll.*, vol. 53, pp. 285–292, 5 text figs.
243. PROTIĆ, M., Geološki sastav i tektonika Stare Planine (Der geologische und tektonische Bau der Stare Planina): *Geol. Inst. Kralj. Jugoslavije*, vol. 4, pp. 80, 81.
244. RAAF, M. DE, La géologie de la nappe du Niesen, entre le Sarine et la Simme: *Matériaux pour la Carte Géol. Suisse*, new ser., vol. 68, pp. 1–105, 14 text figs., pls. 1, 2.
245. RAUSER-TSCHERNOUSSOWA, D., Über die Mikrofauna und die stratigraphische Gliederung eines Profiles des Carbons von Samarskaja Luka: *Naftjanoe Chozaistwo*, 1934 (Russian). (Cited from *Neues Jahrb., 1935, Referate* III, p. 444.) *Non vidi.*
246. REINA, CARLA, Studi paleontologici sul Paleogene dell'Isola di Rodi: *Soc. geol. italiana, Boll.*, vol. 53, pp. 1–68, pls. 1–4.
247. RIVIÈRE, ANDRÉ, Contribution à l'étude géologique de l'Elbourz (Perse): *Rev. géographie phys. et géologie dynamique*, vol. 8, pp. 1–190, 20 text figs., pls. 1–14, 1 pl. with sections, 1 geol. map.
248. ROTH, ROBERT, Type section of Hermosa formation, Colorado: *Am. Assoc. Petro-*

leum Geologists, Bull., vol. 18, pp. 944–947, 1 table.

249. ROTH VON TELEGD, K., Das Gebiet zwischen den Braunkohlenbecken von Esztergom und Tatabánya und die Umgebung des Grabens von Mór.: *Ungar. geol. Anstalt, Jahresber.* 1917–1934, pp. 53–65, 1 text fig.
ROULE, LOUIS, *see* Supplement for the year 1933.

250. ROTO Y GÓMEZ, JOSÉ, Excursión geológica por el norte de la Peninsula: *Soc. española historia nat., Bol.*, vol. 34, pp. 193–196.

251. ROZLOZSNIK, PÁL, Beiträge zur Geologie der Umgebung von Ajka: *Ungar. geol. Anstalt, Jahresber.* 1917–1934, pp. 47–51, 4 text figs.

252. ROZLOZSNIK, PÁL, Geologische Notizen über den westlichen Teil des paläogenen Beckens der Umgebung von Esztergom: *Ungar. geol. Anstalt, Jahresber.* 1917–1934, pp. 67–77, 7 text figs.

253. RUEDEMANN, RUDOLF, Paleozoic plankton of North America: *Geol. Soc. America, Mem.* 2, pp. 1–141, 26 pls., 6 text figs.

254. RÜGER, LUDWIG, Die Baltischen Länder; Estland, Lettland und Litauen: *Handbuch d. Regionalen Geologie*, no. 28, vol. 4, pp. 1–78, 14 text figs., 1 pl.

255. RUTSCH, R., Beiträge zur Kenntnis tropisch-amerikanischer Tertiärmollusken. II, Pteropoden und Heteropoden aus dem Miozän von Trinidad (Britisch Westindien): *Eclogae geol. Helvetiae*, vol. 27, pp. 299–326, pl. 8, 1 text fig.

256. RUTTEN, L. M., Tertiaire Foraminiferen von Oost Celebes: *Geol.-mijnb. genootsch. Nederland en Kolonien, Verh., Geol. ser.*, vol. 10, no. 3, pp. 286–289.
SAMSANOVA, M. F., *see* BRODSKII, A. L., and SAMSANOVA, M. F.

257. SANDON, H., Pseudopodial movements of foraminifera: *Nature*, vol. 133, no. 3368, pp. 761, 762.
SAN MIGUEL DE LA CÁMARA, M., and SOLÉ, LLUIS, *see* Supplement for the year 1933.

258. SCHEFFEN, W., Ein Universaltisch zum Auslesen von Foraminiferen in transparente Zellen: *Senckenbergiana*, vol. 16, pp. 303–308, 6 text figs.

259. SCHENCK, HUBERT G., Significance of *Lepidocyclina* in California (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 302, June, 1934.

260. SCHINZ, H. R., and PEYER, B., Über die Anwendungsmöglichkeiten der Röntgenuntersuchung in der Zoologie: *Acta Radiologica*, vol. 15, pp. 380–408, 9 text figs., 6 pls.

261. SCHMID, KURT, Biometrische Untersuchungen an Foraminiferen [*Globorotalia menardii* (d'Orb.) *Globorotalia tumida* Brady und *Truncatulina margaritifera* Brady typ.—*Truncatulina margaritifera* Brady var. *granulosa* Fischer] aus dem Pliocaen von Ceram (Niederländisch-Indien): *Eclogae geol. Helvetiae*, vol. 27, pp. 45–134, pls. 2–4, 4 text figs., 14 tables.

262. SCHMIDT, ELIGIUS R., A Pestszenterzsébeti (Gubacsi-Hid Melletti) mélyfurás stratigráfai viszonyai (Die stratigraphischen etc. Verhältnisse der salzhaltigen Tiefbohrung von Pestzenterzsébet bei Budapest): *Földtani Közlöny*, vol. 64, pp. 12–14.

263. SCHNETZER, ROBERT, Nummuliten und Orbitolinen aus dem Gilboagebirge in Palästina: *Centralbl. Mineralogie*, Abt. B., pp. 19–27, 4 text figs.

264. SCHNETZER, ROBERT, Foraminiferen des Betzensteiner Kreidekalkes. Studien über die fränkische albüberdeckende Kreide III.: *Centralbl. Mineralogie*, Abt. B., pp. 86–95, 9 text figs.

265. SCHNETZER, ROBERT, Foraminiferen aus der fränkischen albüberdeckenden Kreide. Studien über die fränkische albüberdeckende Kreide V.: *Centralbl. Mineralogie*, Abt. B, pp. 272–279, 6 text figs.

266. SCHOTT, WOLFGANG, Die jüngste Vergangenheit des äquatorialen Atlantischen Ozeans auf Grund von Untersuchungen an Bodenproben der "Meteor"-Expedition: *Naturf. Gesell. Rostock, Sitzungsber. u Abh.*, (3), vol. 4, pp. 48–59, 3 text figs.

267. SCHOTTLER, WALTER, Die Geologie der westlichen Sachranger Berge in den Chiemgauer Alpen (Hochriss-Laubenstein-Spitzsteingebiet): *Neues Jahrb.*, Abt. B, pp. 46-ff., pls. 4, 5, 1 map.

268. SCHRÉTER, ZOLTÁN, Beiträge zur Geologie des Borsod-Heveser Bükkgebirges unde des neogenen Hügellandes seiner Umgebung: *Ungar. geol. Anstalt, Jahresber.* 1917–1934, pp. 103–114.

269. SCHUH, FR., Hans Klähn.: *Geol. Rundschau*, vol. 25, pp. 222–224.

270. SHUPACK, BENJAMIN, Some foraminifera from western Long Island and New York Harbor: *Am. Mus. Novitates*, no. 737, pp. 1–12, 2 pls., 1 text fig.

271. SCOTT, GAYLE, Age of the Midway group: *Geol. Soc. America, Bull.*, vol. 45, pp. 1111–1158, 1 text fig., pls. 132–134.

272. SECRIST, MARK H., Technique for the recovery of Paleozoic arenaceous foraminifera: *Jour. Paleontology*, vol. 8, pp. 245, 246.

273. SENN, A., Die stratigraphische Verbreitung der Orbitoiden: *Schweizer. naturf. Gesell., Verh.*, pp. 339–340, 1934.

274. SHERBORN, C. DAVIES, and GRIFFIN, FRANCIS J., On the date of publication of the natural history portion of Alcide d'Orbigny's "Voyage Amérique Méridionale": *Annals Mag. Nat. Hist.*, (10), vol. 13, no. 73, pp. 130–134.

275. SILVESTRI, ALFREDO, Su di alcuni foraminiferi terziarii della Sirtica: *R. accad. d'Italia*, pp. 1–28, pls. 1–3.

276. SILVESTRI, ALFREDO, De petris, saxis et fossilibus palaeozoici superioris a missione italica geografica in Caracorúm inventis.: *Scientiarum Nuncius Radiofonicus, Citta del Vaticano*, no. 30, 28 mart. pp. 7–10.

277. SILVESTRI, ALFREDO, Rocce e fossili del Paleozoico superiore raccolti della spedizione geografica italiana nel Caracorum (1929). Parte I; Le Rocce: *Pont. accad. sci. Nuovi Lincei, Mem.*, (3), vol. 1, pp. 33–47, pls. 1, 2.

SIMIĆ, V., *see* Supplement for the year 1933.

SOLÉ, LLIUS, *see* SAN MIGUEL DE LA CÁMARA, M., and SOLÉ, LLIUS.

278. SOLIGNAC, MARCEL, Resultats géologiques et hydrologiques du sondage No.3 de Ben Gardane (Extrême-sud tunisien): *Acad. sci. Paris, Comptes rendus*, vol. 199, pp. 1142–1144.

279. SOLIGNAC, MARCEL, and BERKALOFF, EUGÈNE, Le Permien marin de l'extrême-sud Tunisien. I. Considérations générales; Le Djebel Tebaga.: *Service carte géol. Tunisie, Mém.*, new ser., vol. 1, pp. 1–73, 1 pl., 3 text figs.

SOLIGNAC, M., *see* DONCIEUX, L., PAVANS DE CECCATTY, R., and SOLIGNAC, M.

280. SOLOMONICA, PAUL, Die Grenzregion zwischen Flysch und Kalkalpen von der Traisen bis zur Mank: *Akad. Wiss. Wien, Math.-naturwiss. Kl., Anz.*, no. 17, pp. 221–223.

281. SORRENTINO, STEFANO, Considerazioni sulla variabilità dei caratteri di *Alveolina* e *Flosculina* dal punto di vista del loro raggruppamento e determinazione. I. Contributo: *Soc. naturalisti Napoli, Boll.*, vol. 46, Atti, pp. 121–152, 2 pls.

282. SORRENTINO, STEFANO, Sulla presenza d'un terreno oligocenico nei dintorni di Buonalbergo (Benevento): *R. accad. Lincei, Cl. sci. fis., mat. e nat., Rend.*, (6), vol. 19, fasc. 5, pp. 340–342.

283. SOUKUP, JOSEF, Křídová fauna z konecchlumí u Jičína (Die Kreidefauna von Konecchlumi bei Jičin): *Stat. Geol. Ust. Č. Sl. Rep., Zvlášt. otisk. věst.*, vol. 9, no. 5, pp. 257–264. (Czechoslovakian with German summary.)

284. SPARCK, R., Contributions to the animal ecology of the Franz Joseph Fjord and adjacent East Greenland waters. II.: *Meddedelser om Grönland*, vol. 100, pp. 25–36, 6 pls. *Non vidi.*

285. SUJKOWSKI, Z., Skaly kredowe między miastami Pilica i Szczekociny: (Roches crétacées entre les villes Pilica et Szczekociny): *Service géol. Pologne, Bull.*, vol. 8, (1), pp. 37–74, pls. 2–6, 4 text figs.

286. TABER, STEPHEN, Sierra Maestra of Cuba, part of the northern rim of the Bartlett trough: *Geol. Soc. America, Bull.*, vol. 45, pp. 567–620, pls. 57–85, 4 figs.

287. TAN SIN HOK, Über mikrosphäre Lépidocyclinen von Ngampel (Rembang, Mitteljava): *De Ingenieur in Nederlandsch-Indie*, vol. 1, sect. 4, pp. iv.203–iv.211, 4 text figs., pls. 1, 2.

TEAGLE, JOHN, *see* ELLISOR, ALVA C., and TEAGLE, JOHN.

288. THALMANN, HANS, E., Supplement to bibliography and index to genera and species of foraminifera for the year 1931: *Jour. Paleontology*, vol. 8, pp. 238–244.

289. THALMANN, HANS E., Regional distribution of the genus *Globotruncana* Cushman, 1927, in the Upper Cretaceous sediments (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 111, June, 1934.

290. THALMANN, HANS E., Über geographische Rassenkreise bei fossilen Foraminiferen: *Paleont. Zeitschr.*, vol. 16, pp. 115–121.

291. THALMANN, HANS E., Bibliography and index to new genera and species of foraminifera for the year 1932: *Jour. Paleontology*, vol. 8, pp. 356–387.

292. THALMANN, HANS E., *Lepidocyclina canellei* Lemoine and R. Douvillé im Oligozän von Tabasco (Mexiko): *Centralbl. Mineralogie*, Abt. B., pp. 446–448.

293. THALMANN, HANS E., Mitteloligozän in der Umgebung von Tampico (Mexiko): *Geol. Rundschau*, vol. 25, pp. 325–329.

294. THALMANN, HANS E., Die regionalstratigraphische Verbreitung der oberkretazischen Foraminiferengattung *Globotruncana* Cushman, 1927: *Eclogae geol. Helvetiae*, vol. 27, pp. 413–428, 1 text fig.

295. THALMANN, HANS E., Mitteilungen über Foraminiferen I: 1. Über *Rotalia* (*Turbinulina*) *gaimardi* d'Orbigny, 1826: *Eclogae geol. Helvetiae*, vol. 27, pp. 428–431, text fig. 1.

296. THALMANN, HANS E., Mitteilungen über Foraminiferen I: 2. Über *Rotalia conoides* (d'Orbigny, 1826): *Eclogae geol. Helvetiae*, vol. 27, pp. 431, 432, text figs. 2, 3.

297. THALMANN, HANS E., Mitteilungen über Foraminiferen I: 3. Über eine Kartothek der publizierten Gattungen und Arten der Foraminiferen: *Eclogae geol. Helvetiae*, vol. 27, pp. 432–437, 2 text figs.

298. THALMANN, HANS E., Mitteilungen über Foraminiferen I: 4. Zwei neue Arten der Gattung *Rotalia* Lamarck, 1804, aus

dem Plio-Pleistozän von Java: *Eclogae geol. Helvetiae*, vol. 27, pp. 437–440, pl. 11.

THOMAS, H. DIGHTON, *see* COX, L. R., and THOMAS, H. DIGHTON.

299. THOMPSON, M. L., The Fusulinids of the Des Moines series of Iowa: *Univ. Iowa, Studies. in Nat. Hist.*, new ser., no. 284, vol. 16, no. 4, pp. 273–332, pls. 20–23.

300. THORP, E. M., Preliminary remarks on the calcareous shallow-water marine deposits of Florida and the Bahamas: *Jour. Sedimentary Petrology*, vol. 4, pp. 111, 112.

301. THORSON, G., Contributions to the animal ecology of the Scoresby Sound Fjord Complex (East Greenland): *Meddedelser om Grönland*, vol. 100, pp. 5–67, 6 pls., 3 figs. *Non vidi.*

302. TOBORFFY, GÉZA VON, Über die geologischen Altersgrenzen des Oligozäns in der Umgebung von Budapest: *Ungar. Geol. Anstalt, Jahresber.* 1917–1934, pp. 39–42.

303. TOLMACHOFF, I. P., A Miocene microfauna and flora from the Atrato River, Colombia, South America: *Carnegie Mus., Annals*, vol. 23, pp. 275–356, pls. 39–44, 1 map.

304. TOMOR-THIRRING, J., A bakony dudaroszlopi "Sürü" hegycsoportjának földtani es öslénytani viszonyai. (Die geologischen und palaeontologischen Verhältnisse der Dudar-Oszloper Sürü-Gibirgsgruppe in Bakony): *Univ. Budapest, Dissertation, Beitr. zu Földt. Szemle*, pp. 1–47, 2 pls. 1 map. (Hungarian with German summary.)

305. UMBGROVE, J. H. F., Tijd en type der tertiaire plooingen binnen de zone van sterk negatieve afwijkingen der zwartekracht in den Indischen Archipel: *Nederlandsch Aardrijksk. Genootschap, Amsterdam, Tijdschr.* (2), vol. 51, pp. 20–34.

URŠIC, F., *see* Supplement for the year 1933.

306. VAUGHAN, T. WAYLAND, A note on *Orbitoides browni* (Ellis) Vaughan: *Jour. Paleontology*, vol. 8, pp. 70–72.

307. VAUGHAN, T. WAYLAND, Note on *Orbitoides browni* (Ellis) Vaughan (Abstract): *Geol. Soc. America, Proc. for 1933*, p. 376, June, 1934.

308. VENZO, SERGIO, Il Cattiano di monte Brione presso Riva del Garda e la sua nuova fauna: *Soc. Studi per la Venezia Tridentina, Riv.*, vol. 14, fasc. 3, pp. 1–19, pls. 1, 2, *1933.*

309. VLERK, I. M. VAN DER, Verslag over een onderzoek van zeven gesteentemonsters van Noord Boengkoe: *Geol.-mijnb. genootsch. Nederland en Kolonien, Verh., Geol. ser.*, vol. 10, no. 3, p. 290.

310. VLERK, I. M. VAN DER, and DOZY, J. J., The Tertiary rocks of the Celebes-Expedition, 1929. Bijlage D; van de Geologische Onderzoekingen op het eiland Celebes enz. door H. A. BROUWER: *Geol.-mijnb. genootsch. Nederland en Kolonien, Verh., Geol. ser.*, vol. 10, no. 2, pp. 183–217, 2 text figs., 7 sketch maps, pls. 1, 2.

311. VOGL, VIKTOR, Beiträge zur Kenntnis der eozänen Bildungen des Liptóer Beckens: *Ungar. geol. Anstalt, Jahresber.* 1917–1934, pp. 285–287.

312. WAAGEN, L., Aufnahmebericht über das Kartenblatt Graz (5755): *Geol. Bundesanstalt Wien, Verh.*, pp. 42–45.

313. Wadia, D. N., The Cambrian-Trias sequence of northwestern Kashmir (parts of Muzaffarabad and Baramula districts): *India Geol. Survey, Rec.*, vol. 68, pp. 121–176, pl. 12.

WALLACE, W. E., *see* HOWE, HENRY V., and WALLACE, W. E.

314. WARTHIN, A. S., Foraminifera from the Ross Sea: *Am. Mus. Novitates*, no. 721, pp. 1–4, 5 text figs.

315. WETZEL, W., Beiträge zur Geologie von Spanisch-Marokko: *Centralbl. Mineralogie*, Abt. B, pp. 414–419, 2 text figs.

316. WHEELER, HARRY E., The Carboniferous-Permian dilemma: *Jour. Geology*, vol. 42, pp. 62–70, 1 fig.

317. WHIPPLE, G. LESLIE, Larger foraminifera from Vitilevu, Fiji: in LADD: Geology of Vitilevu, Fiji: *B. P. Bishop Mus., Bull.* 119, pp. 141–153, 1 text fig., pls. 19–23.

318. WIJKERSLOOTH, P. DE, Bau und Entwicklung des Apennins, besonders der Gebirge Toscanas: *Geol. Inst. Amsterdam*, pp. 1–426, 14 text figs., 7 pls.

319. WINKLDER-HERMADEN, ARTUR, Neue Studienergebnisse aus dem mittleren und oberen Isonzo-Gebiet: *Akad. Wiss. Wien, Math.-naturwiss. Kl., Anz.*, pp. 56–59.

320. WOLOGDIN, A., Das Wachio-Gebiet (Darwas und das Gebirge "Peter der Grosse"): *Tadschikische Komplex-Expedition 1932, Akad. Wiss. Leningrad*, pp. 289–322, *1933* (Russian). *Non vidi.*

321. WRIGLEY, ARTHUR, A Lutetian fauna at Southampton docks: *Geologists' Assoc. London, Proc.*, vol. 45, pp. 1–16, 17 text figs.

322. YABE, H., and MABUTI, S., Some geological observations in Nariwa region, Bittyû province, Japan (in Japanese): *Geol. Soc. Tokyo, Jour.*, vol. 41, no. 487. *Non vidi.*

323. YOVANOVITCH, B., Sur un sondage pro-

fond dans le Nummulitique de Si Ameur el Hadi (Maroc septentrional): *Soc. géol. France, Compte rendu*, pp. 68, 69.
YUSSEN, JOVA CLARA, *see* Supplement for the year 1931.

324. ZAPLETAL, K., Vývoj, horniny, zkameneliny a stavba Vyškorska (Entwicklung, Gesteine, Versteinerungen und Bau des Vyškover Gebietes): *Vlast. sborník okr. vyškovského*, vol. 1, příroda no. 3, pp. 1–31, 6 text figs., 1 map, 1 pl. (Czechoslovakian).

SUPPLEMENT TO BIBLIOGRAPHY FOR THE YEAR 1931

(For Nos. 1–234, see *Jour. Paleontology*, vol. 7, pp. 342–349, and 356–372, and *Jour. Paleontology*, vol. 9, pp. 715–732.)

325. YUSSEN, JOVA CLARA, Probable origen marino de la formación petrolífera de Plaza Huincul: *Informac. Petrolif. Buenos Aires, Bol.*, vol. 7, no. 84, pp. 1–10, 46 text figs. (=No. 235 for the year 1931.)

SUPPLEMENT TO BIBLIOGRAPHY FOR THE YEAR 1932

(For Nos. 1–317, see *Jour. Paleontology*, vol. 8, pp. 356–372, and vol. 9, pp. 715–732.)

326. BATALLER, J. R., Excursión cientifica por Mallorca: *Iberica, Barcelona*, no. 945, reprint, 11 pp., 39 text figs. (=No. 310 for the year 1932.)
327. DOUTKEVITCH, G. A., Geologitchiéskié issliédovaniia na vostotchnoi okrainié tchousovskogho niéftiénosnogho raiona (zaladnvii sklon sriédniégho ourala): *Neftianogo Geol.-Razviéd, Inst.*, ser. A, vol. 30, pp. 1–72, 8 text figs., 1 map, pl. 6 (in Russian). *Non. vidi.* (=No. 319 for the year 1932.)

SUPPLEMENT TO BIBLIOGRAPHY FOR THE YEAR 1933

(For Nos. 1–356, see *Jour. Paleontology*, vol. 9, pp. 715–732.)

328. COX, L. R., Stratigraphy and paleontology (of Central Arabia): in PHILBY, *The Empty Quarter*, London, pp. 383–389. (=No. 357 for the year 1933.)
329. DARDER I PERICÀS, B., Dues notes sobre geologia de la Serra de Llevant de Mallorca. I: L'existència del Burdigalià a la Serra de Farrutx (Artà): *Inst. Catalan. Hist. Nat., Bull.*, vol. 33, pp. 1, 2, Madrid. (=No. 358 for the year 1933.)
330. DEECKE, W., Was lehrt uns das Pliozän von Agrigenta über mesozoische Sedimentation? : *Deutsche geol. Gesell., Zeitschr.*, vol. 85. (=No. 359 for the year 1933.)
331. ISHIJIMA, W., On three species of *Corallinaceae* lately obtained from the Megamiyama limestone, Sagara district, prov. Totomi, Japan: *Japanese Jour. Geology and Geography*, vol. 11, nos. 1, 2. (=No. 360 for the year 1933.)
332. ROULE, LOUIS, Notice biographique sur Alcide Dessalines d'Orbigny (1802–1857): *Mus. nat. histoire nat., Pub.* no. 3, pp. 7–13, 1 portrait. (=No. 361 for the year 1933.)
333. SAN MIGUEL DE LA CÁMARA, M., and SOLÉ, LLIUS, Geologia del massís de Montgrí: *Inst. Catalan. Hist. Nat., Bull.*, vol. 33, pp. 129–145, 5 text figs., pls. 1–3. (=No. 362 for the year 1933.)
334. SIMIĆ, V., Das Oberperm in Westserbien (Gornji perm u zapadnoj srbiji): *Service géol. Yougoslavie, Mém.*, vol. 1, pp. 1–130, 10 text figs., 10 pls., (Serbian with German summary). (=No. 363 for the year 1933.)
SOLÉ, LLIUS, *see* SAN MIGUEL DE LA CÁMARA, M., and SOLÉ, LLIUS.
335. URŠIC, F., Geologische Betrachtungen entlang des westlichen Umfanges der Save-Tertiärzone in Slowenien: *Ann. Géol. Pénins. Balkanique*, vol. 11, pp. 78–98, 8 text figs., 3 pls. (Slovenian with German summary.) (=No. 364 for the year 1933.)

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——— *foliaceus* (H. B. Brady, 1884) var. *recurva* Earland, **89,** 93, pl. 3, figs. 14–17. Recent, Antarctic.

——— sp. Chapman, Howchin and Parr, **36,** 188. (For *Haplophragmium agglutinans* Chapman and Howchin, 1905, *Geol. Survey New South Wales, Mem.,* no. 14, p. 7, pl. 1., fig. 5.) Permian, Australia.

Ammocibicides n. gen., Earland, **89,** 106. Fam. Lituolidae. Genotype: *A. proteus* Earland, 1934. Recent, Antarctic.

——— *pontoni* Earland, **89,** 107, pl. 4, figs. 8–12. Eocene, Alabama.

——— *proteus* Earland, **89,** 106, pl. 3, figs. 53, 54. Recent, Antarctic.

Ammodiscus planoconveza Chapman, Howchin and Parr, **36,** 186. [For *Truncatulina haidingeri* Chapman and Howchin, 1905 (not d'Orbigny, 1846), *Geol. Survey New South Wales, Mem.,* no. 14, p. 18, pl. 3, fig. 3.] Lower Permian, New South Wales, Australia.

Ammoflintina n. gen., Earland, **89,** 98. Fam. Lituolidae. Genotype: *A. trihedra* Earland, 1934. Recent, Antarctic.

——— *trihedra* Earland, **89,** 98, pl. 3, figs. 20–23. Recent, Antarctic.

Amphistegina cubensis D. K. Palmer, **221,** 256, pl. 15, fig. 2.; text figs. 16, 17. Eocene, Cuba.

——— *lopeztrigoi* D. K. Palmer, **221,** 254, pl. 15, figs. 6, 8. Eocene, probably middle part, Cuba.

Anomalina bentonensis Morrow, **202,** 201, pl. 30, fig. 4. Upper Cretaceous, Kansas.

——— *hughesi* Rankin, in Cushman and Kleinpell, **64,** 23, pl. 3, fig. 13. Miocene, California.

——— sp. Morrow, **202,** 201, pl. 30, fig. 9. Upper Cretaceous, Kansas.

Astacolus sp. Eichenberg, **90,** 159, pl. 10, fig. 9. Lower Cretaceous, Hauterivian, Germany.

——— sp. Eichenberg, **90,** 159, pl. 11, fig. 18. Lower Cretaceous, Hauterivian, Germany.

——— sp. Eichenberg, **90,** 159, pl. 13, fig. 10. Lower Cretaceous, Hauterivian, Germany.

Asterocyclina monticellensis Cole and Ponton, **44,** 141, pl. 2, figs. 6–11. Eocene, Florida.

Asterodiscus sp. Flandrin, **96,** 262, pl. 16, fig. 12. Upper Eocene, Algeria.

?*Asterorbis aguayoi* D. K. Palmer, **221,** 246, pl. 13, fig. 7. Upper Cretaceous, Matanzas province, Cuba.

?——— *cubensis* D. K. Palmer, **221,** 249, pl. 13, figs. 6, 9, 10; pl. 14, fig. 9. Upper Cretaceous, Santa Clara province, Cuba.

?——— *havanensis* D. K. Palmer, **221,** 251, pl. 13, fig. 11; text figs. 13, 14. Upper Cretaceous, Havana province, Cuba.

?——— *macei* D. K. Palmer, **221,** 247, pl. 13, fig. 8; text figs. 9, 10. Upper Cretaceous, Havana province, Cuba.

Astrorhiza polygona Earland, **89,** 53, pl. 1, figs. 13, 14. Recent, Antarctic.

Bathysiphon argillaceus Earland, **89,** 60, pl. 1, fig. 10. Recent, Antarctic.

——— *sanctaecrucis* Cushman and Kleinpell, **64,** 1, pl. 1, figs. 1, 2. Miocene Vaqueros formation, California.

——— sp. Tolmachoff, **303,** 291, pl. 40, figs. 2, 3. Miocene, Colombia, South America.

?*Bigenerina* sp. Eichenberg, **90,** 152, pl. 15, fig. 6. Lower Cretaceous, Hauterivian, Germany.

Bitubulogenerina n. gen., Howe, **141,** 420. Fam. Buliminidae? Genotype: *B. vicksburgensis* Howe, 1934. Eocene and Oligocene, Louisiana, Mississippi.

Bitubulogenerina hiwannensis Howe, **141,** 421, pl. 51, fig. 2. Oligocene, Mississippi.

——— *mauricensis* Howe, **141,** 421, pl. 51, fig. 6. Eocene, Claiborne, Louisiana.

——— *montgomeryensis* Howe, **141,** 421, pl. 51, fig. 9. Upper Eocene, Jackson, Louisiana.

——— *vicksburgensis* Howe, **141,** 420, pl. 51, fig. 7. Oligocene, Vicksburg, Mississippi.

Bolivina barbarana Cushman and Kleinpell, **64,** 11, pl. 2, fig. 5. Miocene, California.

——— *dentata* Brotzen, **27,** 59, pl. 1, fig. *b* (misprint for fig. *a* on pl. 1). Upper Senonian-Danian, Palestine.

——— *girardensis* Rankin, in Cushman and Kleinpell, **64,** 17, pl. 3, fig. 7. Miocene, California.

——— *goudkoffi* Rankin, in Cushman and Kleinpell, **64,** 22, pl. 4, figs. 4, 5. Miocene, California.

——— *granti* Rankin, in Cushman and Kleinpell, **64,** 21, pl. 4, figs. 2, 3. Miocene, California.

——— *hootsi* Rankin, in Cushman and Kleinpell, **64,** 18, pl. 4, fig. 1. Miocene, California.

Bolivina hughesi Cushman, 1929, var. *parva* Cushman and Galliher, **61,** 25, pl. 4, fig. 10. Miocene, Monterey shale, California.

——— *marginata* Cushman, 1908, var. *adelaidana* Cushman and Kleinpell, **64,** 10, pl. 2, figs. 1, 2. Miocene, California.

——— ——— Cushman, var. *gracilis* Cushman and Kleinpell, **64,** 10, pl. 2, fig. 3. Miocene, lowermost Modelo formation, California. (According to Art. 11 of the *International Rules of Zoological Nomenclature* the varietal name is already preoccupied by the specific name of Cushman and Applin, 1936.)

——— *modeloensis* Cushman and Kleinpell, **64,** 10, pl. 2, fig. 4. Miocene, base of Modelo formation, California.

——— *obliqua* Barbat and Johnson, **11,** 15, pl. 1, fig. 20. Upper Miocene, California.

——— sp.? Barbat and Johnson, **11,** 16, pl. 1, fig. 19, Upper Miocene, California.

Borelia n. subgen., Sorrentino, **281,** 137. New subgenus of *Fasciolites* Parkinson, 1811. No subgenotype designated. Fam. Alveolinidae. (This name is a misnomer and should, therefore, not be confused with *Borelis* de Montfort, 1808).

Botellina goësii Earland, **89,** 78, pl. 2, figs. 23–26. [For *Botellina labyrinthica* Goës, 1894, (not H. B. Brady, 1881), J. Wright, 1902 (not H. B. Brady), Heron-Allen and Earland, 1916, 1932 (not H. B. Brady), Cushman, 1918, 1920 (not H. B. Brady.)] Recent, Antarctic.

Boultonia cylindrica Chen, **40,** 39, pl. 6, figs. 7–9. Lower Permian, Maping limestone, Kwangsi, China.

Bulimina carnerosensis Cushman and Kleinpell, **64,** 5, pl. 1, fig. 12. Miocene, California.

——— ——— Cushman and Kleinpell var. *mahoneyi* Cushman and Kleinpell, **64,** 5, pl. 1, fig. 13. Miocene, California.

——— *delreyensis* Cushman and Galliher, **61,** 25, pl. 4, fig. 8. Miocene, Monterey shale, California.

——— *reussi* Morrow, **202,** 195, pl. 29, fig. 12. [For *B. ovulum* Reuss, 1845, (not *B. ovula* d'Orbigny, 1839), *Verst. Böhm. Kreide,* pt. 1, p. 37, pl. 8, fig. 57; pl. 13, fig. 73.] Upper Cretaceous, Kansas.

——— *sellini* Brotzen, **27,** 59, pl. 4, fig. *a.* Upper Senonian-Danian, Palestine.

——— sp. Morrow, **202,** 196, pl. 29, figs. 11, 14, 16. Upper Cretaceous, Kansas.

——— *uvigerinaformis* Cushman and Kleinpell, **64,** 5, pl. 1, fig. 14. Miocene, California.

Buliminella dubia Barbat and Johnson, **11,** 13, pl. 1, figs. 14, 15. Upper Miocene, California.

——— *henryana* Cushman and Kleinpell, **64,** 4, pl. 1, fig. 11. Miocene, Monterey shale, California.

——— *pulchra* Tolmachoff, **303,** 305, pl. 40, fig. 28. Miocene, Colombia, South America.

Camerina bonleoensis Henrici, **131,** 25, pl. 1, fig. 5; text fig. 6. [For *Nummulites bagelensis II* in Waterschoot v. d. Gracht, 1915, *Jaarb. mijnwezen Ned-Indië,* vol. 43, Verh. 2, pl. 55, text figs. 7–9, 1914.). Lutetian Eocene, Timor, D.E.I.

——— *borneënsis* Caudri, **32,** 56. [For *Nummulites nuttalli* van der Vlerk, 1929 (not Davies, 1927), *Wetensch. Mededeel. Dienst Mijnbouw Ned.-Indie,* no. 9, p. 19, text figs. 11 *a, b,* 34 *a, b.*] Lower Tertiary, Soemba, D.E.I.

——— *chawneri* D. K. Palmer, **221,** 261, pl. 16, figs. 3, 6, 7; text fig. 19. Upper Oligocene, Cuba.

——— *crasseornata* Henrici, **131,** 32, pl. 2, figs. 2–5, 12, text fig. 15. Lower Eocene, Ypresian, Timor, D.E.I.

?——— *cubensis* D. K. Palmer, **221,** 245, pl. 14, figs. 3, 5, 7. Upper Cretaceous, Santa Clara province, Cuba.

?——— *dickersoni* D. K. Palmer, **221,** 243, pl. 14, figs. 1, 2, 4, 6, 8; text figs. 4. 5. Upper Cretaceous, Santa Clara province, Cuba.

——— *discoidea* Caudri, **32,** 63, pl. 1, figs. 7, 8. Lower Tertiary, a_2, Soemba, D.E.I.

——— *gilboensis* (Doncieux, ms.) Schnetzer, **253,** 19, text figs. 1, 2. (For *Nummulites gilboensis* Doncieux, 1928, *nomen nudum,* in Picard, 1928, *Centralbl. Mineralogie,* Abt. B., p. 581.) Eocene, Palestine.

——— *kemmerlingi* Caudri, **32,** 60, pl. 1, figs. 3, 6. Lower Tertiary a_2, Soemba, D.E.I.

——— *picardi* (Doncieux, ms.) Schnetzer, **263,** 22, text figs. 3, 4. (For *Nummulites picardi* Doncieux, 1928, *nomen nudum,* in Picard, 1928, *Centralbl. Mineralogie,* Abt. B., p. 581.) Eocene, Palestine.

——— *taballarensis* Caudri, **32,** 59. [For *Nummulites thalicus* van der Vlerk, 1929 (not Davies, 1927), *Wetensch. Mededeel. Dienst Mijnbouw Ned.-Indie,* no. 9, p. 21, figs. 13, 36.] Lower Eocene, Tertiary a, Soemba, D.E.I.

——— see also *Nummulites.*

Cancris baggi Cushman and Kleinpell, **64,** 15, pl. 3, fig. 2. Miocene, Monterey shale, California.

Candeina biloba Jedlitschka, **150,** 22, text figs. 8–12. Miocene, Czechoslovakia.

——— *triloba* Jedlitschka, **150,** 23, text figs. 13–18, 20. Miocene, Czechoslovakia. (Preoccupied by *Candeina nitida,* d'Orbigny, 1839 var. *triloba* Cushman, 1921.)

Candorbulina n. gen., Jedlitschka, **150,** 21. Fam. Globigerinidae. Genotype: *C. universa* Jedlitschka, 1934. Miocene, Czechoslovakia.

——— *universa* Jedlitschka, **150,** 21, text figs. 1–7, 19. Miocene, Czechoslovakia.

Cassidulina barbarana Cushman and Kleinpell, **64,** 16, pl. 3, fig. 5. Miocene, California.

——— *lens* Earland, **89,** 135, pl. 6, figs. 17–20. Recent, Antarctic.

——— *modeloensis* Rankin, in Cushman and Kleinpell, **64,** 23, pl. 3, fig. 12. Miocene, California.

——— *monicana* Cushman and Kleinpell, **64,** 16, pl. 3, fig. 4. Lower Miocene, California.

Checchiaites n. subgen., Sorrentino, **281,** 137. Fam. Alveolinidae. New subgenus of *Flosculina* Stache, 1880. Subgenotype: *Flosculina daunica* Checchia-Rispoli, 1912. Eocene, Italy.

Chilostomella sp. Hadley, **121,** 24 (128), pl. 2, figs. 20, 21. Upper Eocene, Cuba.

Chrysalogonium breviloculum Cushman and Jarvis, **63,** 74, pl. 10, fig. 13. Lower Miocene, Trinidad, B.W.I.

——— *elongatum* Cushman and Jarvis, **63,** 73, pl. 10, figs. 10, 11. Lower Miocene, Trinidad, B.W.I.

——— *lanceolum* Cushman and Jarvis, **63,** 75, pl. 10, fig. 16. Lower Miocene, Trinidad, B.W.I.

——— *longicostatum* Cushman and Jarvis, **63,** 74, pl. 10, fig. 12. Lower Miocene, Trinidad, B.W.I.

Cibicides Atratiensis Tolmachoff, **303,** 338, pl. 42, figs. 16–18. Miocene, Colombia, South America.

——— *colombianus* Tolmachoff, **303,** 337, pl. 42, figs. 12–15. Miocene, Colombia, South America.

——— *concavus* Tolmachoff, **303,** 339, pl. 42, figs. 22–24. Miocene, Colombia, South America.

——— *depressus* Tolmachoff, **303,** 338, pl. 42, figs. 19–21. Miocene, Colombia, South America. (Not *Truncatulina depressa* d'Orbigny, 1839.)

——— *grossepunctatus* Earland, **89,** 184, pl. 8, figs. 39–41. Recent, Antarctic.

——— *nephridium* Tolmachoff, **303,** 340, pl. 42, figs. 25–27. Miocene, Colombia, South America.

——— *refulgens* Montfort, 1808, var. *corticata* Earland, **89,** 183, pl. 8, figs, 46–48. Recent, Antarctic.

——— *victoriensis* Chapman, Parr and Collins, **37,** 571, pl. 11, fig. 16. [For *Truncatulina mundula* Chapman and Crespin, 1928 (not Brady, Parker, and Jones, 1888), *Victoria Geol. Survey, Rec.*, vol. 5, pt. 1, p. 88.] Oligocene, Victoria, Australia.

Cibicorbis n. gen., Hadley, **121,** 26 (130). Family not indicated. Genotype. *C. herricki* Hadley, 1934. Oligocene, Cuba.

——— *herricki* Hadley, **121,** 26 (130), pl. 5, figs. 1–3. Oligocene, Cuba.

Clavulina sp. Hadley, **121,** 9 (113), pl. 1, fig. 7. Oligocene, Cuba.

——— sp. Hadley, **121,** 9 (113), pl. 1, fig. 8. Oligocene, Cuba.

Coleites n. gen., Plummer, **235,** 605. No Family given. Genotype: *Pulvinulina reticulosa* Plummer, 1927. Eocene Midway, Wills Point formation, Texas.

Cristellaria dietrichii Brotzen, **27,** 52. Description given, but without figure. Campanien, Jerusalem, Palestine.

——— *landinensis* Bonte, **24,** 69, pl. 3, figs. 1–3, 8–14; text figs. 1–6. Lower Eocene, Landenian, France.

——— *picardi* Brotzen, **27,** p. 48, pl. 4, fig. *d.* Santonian-Emscherian, Upper Cretaceous, Palestine.

——— *rotulata* (Lamarck, 1804) var. *madiensis* Brotzen, **27,** 50, pl. 2, fig. *c.* Upper Cretaceous, Campanian-Santonian, Palestine.

——— *shalemi* Brotzen, **27,** 47, pl. 2, fig. *b.* Upper Cretaceous, Campanian-Santonian, Palestine.

——— See also *Lenticulina*, *Robulus* etc.

Cyclammina gouldi Warthin, **314,** 4, text figs. 4, 5. Recent, Ross Sea, Antarctic.

Cycloclypeus papillosus Hadley, **121,** 14 (118), pl. 1, fig. 17. Upper Eocene, Cuba.

——— sp. undet. *1*, Henrici, **131,** 36, text fig. 16. Lower Miocene, Aquitanian, Timor, D.E.I.

——— sp. undet. *2*, Henrici, **131,** 36, text fig. 17. Lower Miocene, Aquitanian, Timor, D.E.I.

——— sp. undet., Henrici, **131,** text figs. 18, 19. Lower Miocene, Aquitanian, Timor, D.E.I.

Cyclolepidina n. subgen., Whipple, **317,** 143. Fam. Orbitoididae. New subgenus of *Lepidocyclina* Gümbel, 1868. Subgenotype: *Lepidocyclina* (*Cyclolepidina*) *suvaensis* Whipple, 1934. Miocene, Vitilevu, Fiji. (See *Lepidocyclina*.)

Cystammina argentea Earland, **89,** 105, pl. 4, figs. 17–19. Recent, Antarctic.

Delosina complanata Earland, **89,** 128. [For *Polymorphina complexa* Sidebottom, 1907, *Manchester Lit. Philos. Soc., Mem. and Proc.*, vol. 51, p. 16, pl. 4, figs. 4, 8, (9?).] Recent, Mediterranean Sea.

——— *polymorphinoides* Earland, **89,** 128. (For *Polymorphina complexa* Sidebottom, 1907, *Manchester Lit. Philos. Soc., Mem. and Proc.*, vol. 51, p. 16, pl. 4, figs. 5–7, text fig. 7.) Recent, Mediterranean Sea.

——— *sutilis* Earland, **89,** 129, pl. 5, figs. 1–8. [For *Delosina complexa* (slender form) Wiesner, 1931 (not Sidebottom, 1907), *Foram. Deutsche Südpolar-Exped.*, p. 123, pl. 21, fig. 254.] Recent, Antarctic.

——— *wiesneri* Earland, **89,** 130, pl. 5, figs. 9–15. [For *Delosina complexa* (broad form) Wiesner, 1931 (not Sidebottom, 1907), *Foram. Deutsche Südpolar-Exped.* p. 123, pl. 21, figs. 255, 256.] Recent, Antarctic.

Dentalina barnesi Rankin, in Cushman and Kleinpell, **64,** 17, pl. 3, fig. 6. Miocene, California.

——— *colei* Cushman and Dusenbury, **60,** p. 54, pl. 7, figs. 10–12. [For *Vaginulina legumen* (Linné, 1758,) var. *elegans* Cole, 1927 (not d'Orbigny, 1826), *Bull. Am. Paleontology,* vol. 14, no. 51, p. 21, pl. 3, figs. 10, 11.] Eocene, California.

——— n. sp., Eichenberg, **90,** 170, pl. 15, fig. 2. Lower Cretaceous, Hauterivian, Germany.

——— *rangei* Brotzen, **27,** 36, pl. 1, fig. *e.* Upper Senonian-Danian, Upper Cretaceous, Palestine.

——— *reflexa* Morrow, **202,** 189, pl. 29, figs. 5, 20. Upper Cretaceous, Kansas.

——— *serrata* Eichenberg, **90,** 167, pl. 12, fig. 7. Lower Cretaceous, Hauterivian, Germany.

——— spp. Eichenberg, **90.** The following forms are described and figured by Eichenberg under the rules of the *nomenclatura aperta*: (a) p. 163, pl. 10, fig. 4; (b) p. 163, pl. 10, fig. 7; (c) p. 166, pl. 12, fig. 2; (d) p. 167, pl. 12. fig. 10; (e) p. 167, pl. 12, fig. 11; (f) p. 168, pl. 14, fig. 9; (g) p. 168, pl. 14, fig. 11; (h) p. 169, pl. 14, fig. 12; (i) p. 169, pl. 14, fig. 13; (k) p. 169, pl. 14, fig. 14; and (l) p. 170, pl. 15, fig. 14. Lower Cretaceous, Hauterivian, Germany.

——— sp. Morrow, **202,** 190, pl. 29, fig. 6. Upper Cretaceous, Kansas.

——— sp. Tolmachoff, **303,** 303, pl. 40, fig. 24. Miocene, Colombia, South America.

——— sp. Tolmachoff, **303,** 303, pl. 40, fig. 25. Miocene, Colombia, South America.

——— sp. (? n. sp.) Eichenberg, **90,** 166, pl. 12, fig. 3. Lower Cretaceous, Hauterivian, Germany.

Discocyclina n. sp. (?), form *B*, Caudri, **32,** 92, text fig. 20, Lower Eocene, Tertiary a_2, Soemba, D.E.I.

——— *pygmaea* Henrici, **131,** 47, pl. 3, figs. 7, 12; pl. 4, fig. 4. Probably lower Eocene, Ypresian, Timor, D.E.I.

——— *molengraaffi* Henrici, **131,** 46, pl. 2, fig. 22; pl. 3, figs. 9, 11; pl. 4, figs. 2, 3, 7. Middle Eocene, Lutetian, Timor, D.E.I.

——— sp. Flandrin, **96,** 263, pl. 16, figs. 13–15. Upper Eocene, Algeria.

Discorbis atratiensis Tolmachoff, **303,** 310, pl. 40, figs. 33, 34. Miocene, Colombia, South America.

——— *balcombensis* Chapman, Parr and Collins, **37,** 562, pl. 8, fig. 10. Oligocene, Victoria, Australia.

——— *bertheloti* (d'Orbigny, 1839) var. *papillata* Chapman, Parr and Collins, **37,** 561, pl. 9, fig. 14. Oligocene, Victoria, Australia.

——— *translucens* Earland, **89,** 181, pl. 8, figs. 20–22. Recent, Antarctic.

——— *tuberculata* Balkwill and Wright, 1885, var. *australiensis* Chapman, Parr and Collins, **37,** 563, pl. 8, fig. 9. [For *Discorbis tuberculata* Heron-Allen and Earland, 1924 (not Balkwill and Wright, 1885), *Royal Micr. Soc., Jour.*, p. 169.] Oligocene, Victoria, Australia.

Doliolina termieri Deprat, 1914, var. *pamirensis* Doutkevich, **83,** 83, pl. 1, fig. 10. Permian, eastern Pamir, U.S.S.R.

Dorothia californica Cushman and Kleinpell, **64,** 1, pl. 1, fig. 18. Miocene, California.

Ehrenbergina navalis Hadley, **121,** 23 (127), pl. 5, figs. 4, 5. Oligocene, Cuba.

——— *parva* Earland, **89,** 139, pl. 6, figs. 28–32. Recent, Antarctic.

Ellipsonodosaria cryptocosta Hadley, **121,** 20 (124), pl. 3, fig. 3. Oligocene, Cuba.

——— *dentaliniformis* Cushman and Jarvis, **63,** 73, pl. 10, fig. 9. Lower middle Miocene, Trinidad, B.W.I.

——— *mappa* Cushman and Jarvis, **63,** 73, pl. 10, fig. 8. Lower middle Miocene, Trinidad, B.W.I.

——— *nuttalli* Cushman and Jarvis, **63,** 72, pl. 10 fig. 6. [For *Nodosaria abyssorum* Guppy, 1904 (not H. B. Brady, 1881), *Victoria Inst. Trinidad, Proc.*, vol. 2, p. 12, pl. 1, figs. 10, 11., *N. abyssorum* Guppy, 1904 (not Brady, 1881), *Geol. Mag.* (5), vol. 1, p. 246, pl. 8, figs. 8, 9, and for *N. abyssorum* Nuttall, 1928 (not Brady, 1881), *Geol. Soc. London, Quart. Jour.*, vol. 84, p. 81, pl. 5, fig. 2.] Upper middle Miocene, Trinidad, B.W.I.

——— ——— Cushman and Jarvis var. *gracillima* Cushman and Jarvis, **63,** 72, pl. 10, fig. 7. [For *Nodosaria soluta* Martinotti, 1923 (not Reuss, 1851), *Soc. italiana sci. nat., Atti.*, vol. 62, p. 331, pl. 7, figs. 19, 20, and for *N. knihnitziana* Nuttall, 1928 (not Karrer, 1877), *Geol. Soc. London, Quart. Jour.*, vol. 84, p. 81, pl. 4, figs. 9, 10.] Lower Miocene, Trinidad.

——— *tuckerae* Hadley, **121,** 21 (125), pl. 3, figs. 1, 2. Oliogcene, Cuba.

Elphidium brooklynense Shupack, **270,** 10. fig. 7.

——— *florentinae* Shupack, **270,** 9, fig. 5.

——— *schencki* Cushman and Dusenbury, **60,** 60, pl. 8, fig. 8. Eocene, California.

——— *smithi* Cushman and Dusenbury, **60,** 61, pl. 8, fig. 7. Eocene, California.

Eouvigerina geneae Morrow, **202,** 195, pl. 30. figs. 13, 16, 17, 19. Upper Cretaceous, Kansas.

Epistomina ramonensis Cushman and Kleinpell, **64,** 15, pl. 3, fig. 1. Miocene, California.

Epistominoides n. gen., Plummer, **235,** 602. No family given. Genotype: *Saracenaria wilcoxensis* Cushman and Ponton, 1932. Eocene, Midway, Wills Point formation, Texas.

——— *midwayensis* Plummer, **235,** 605, pl.

24, fig. 4. Eocene, Kincaid formation, Texas.
Eponides bradyi Earland, **89,** 187, pl. 8, figs. 36–38. [For *Truncatulina pygmaea* H. B. Brady, 1884 (not Hantken, 1876), *Challenger Rep.*, p. 666, pl. 95, figs. 9, 10.] Recent, Antarctic.
——— *keenani* Cushman and Kleinpell. **64,** 14, pl. 3, figs. 10, 11. Miocene, California.
——— *limbatus* Tolmachoff, **303,** 315, pl. 41, figs. 7–9. (Not *Rotalia limbata* d'Orbigny, 1826, not *R. limbata* Terquem, 1882). Miocene, Colombia, South America.
——— *ponderosa* Hadley, **121,** 22 (126), pl. 3, figs. 9–11, 14. Upper Eocene, Cuba.
——— *rosaformis* Cushman and Kleinpell, **64,** 14, pl. 2, fig. 18. Miocene, California.
——— *sidebottomi* Earland, **89,** 188, pl. 8, figs. 33–35. Recent, Antarctic.
——— sp. Tolmachoff, **303,** 316, pl. 41, figs. 10–12. Miocene, Colombia, South America.
——— sp. (?) Cushman, **58,** 131, pl. 17, fig. 1. Late Tertiary, Vitilevu.
Eulepidina, see *Lepidocyclina*.

Fabularia vaughani Cole and Ponton, **44,** 139, pl. 1, figs. 1–9. Eocene, Ocala limestone, Florida.
Fasciolites amarassiensis Henrici, **131,** 43, pl. 2, figs. 6, 21. Middle Eocene, Lutetian, Timor, D.E.I.
——— sp. undet., Caudri, **32,** 130, pl. 4, fig. 5. Lower Eocene, Tertiary a_2, Soemba, D.E.I.
——— sp. undet., Caudri, **32,** 133, no figures given.
Fasciolitidae n. fam., Henrici, **131,** 36. Comprises *Fasciolites* Parkinson, 1811 (syn.: *Alveolina* d'Orbigny, 1826; *Flosculina* Stache, 1880). Eocene.
Flabellina crassa Cushman and Kleinpell, **64,** 3, pl. 1, fig. 6. Miocene, California.
——— *cushmani* Morrow, **202,** 194, pl. 29, fig. 25. Upper Cretaceous, Kansas.
——— n. sp. ?, Brotzen, **27,** 45, no figure. Upper Cretaceous, Palestine.
Frondicularia aclis Morrow, **202,** 193, pl. 29, fig. 30. Upper Cretaceous, Kansas.
——— *dunbari* Morrow, **202,** 192, pl. 29, figs. 7, 22. Upper Cretaceous, Kansas.
——— *extensa* Morrow, **202,** 193, pl. 29, fig. 31. Upper Cretaceous, Kansas.
——— *karreri* Oppl, **219,** 52, pl. 1, fig. 1. [Preoccupied by Berthelin, 1880 (*Flabellina*).] Miocene, Troppau, Czechoslovakia.
——— *semistriata* Eichenberg, **90,** 179, pl. 11, fig. 12. Lower Cretaceous, Hauterivian, Germany.
——— sp. Morrow, **202,** 194, pl. 29, fig. 13. Upper Cretaceous, Kansas.
——— sp. Morrow, **202,** 193, pl. 29, figs. 9, 19. Upper Cretaceous, Kansas.
——— sp. (n. sp.?) Eichenberg, **90,** 180, pl. 15, fig. 8. Lower Cretaceous, Hauterivian, Germany.
Fusiella granum-oryzae Doutkevitch, **84,** 9, 60, pl. 1, figs. 1–8. Carboniferous, Uralian, Ural Mountains, U.S.S.R.
——— *euryteines* Thompson, **299,** 310, pl. 22, figs. 4, 13, 14, 18. [For *Fusulinella meeki* Dunbar and Condra, 1927 (not *Fusulina ventricosa meeki* Möller, 1879), *Nebraska Geol. Survey, Bull.* 2, ser. 2, p. 78, pl. 16, figs. 4–6, (?) pl. 2, figs. 12–14; for *?Fusulinella*, n. sp., Henbest, 1928, *Jour. Paleontology*, vol. 2, p. 79, pl. 10, figs. 2, 4; and for *?Fusulina meeki* White, 1932, *Univ. Texas, Bull.* 3211, p. 27, pl. 1, figs. 7–12.] Pennsylvanian, Iowa,
——— *eximia* Thompson, **299,** 323, pl. 23, figs. 7–10. Pennsylvanian, Iowa.
——— *kayi* Thompson, **299,** 303, pl. 21, figs. 1, 2, 4, 5, 8, 12–15, 19, 20. Pennsylvanian Iowa.
——— *lucasensis* Thompson, **299,** 309, pl. 22, figs. 2, 9, 12, 17, 19. Pennsylvanian, Iowa.
——— *megista* Thompson, **299,** 320, pl. 23, figs. 4–6. (For ? *Fusulinella meeki robusta* Dunbar and Condra, 1927, *Nebraska Geol. Survey, Bull.* 2, ser. 2, p. 80, pl. 15, figs. 7, 8.) Pennsylvanian, Iowa.
——— *mysticensis* Thompson, **299,** 319, pl. 23, figs. 1–3. Pennsylvanian, Iowa.
——— *problematica* Thompson, **299,** 306, pl. 21, figs. 6, 9, 11, 16, 17. Pennsylvanian, Iowa.
——— *pumila* Thompson, **299,** 313, pl. 22, figs. 6, 8, 10, 11. Pennsylvanian, Iowa.
——— *stookeyi* Thompson, **299,** 316, pl. 22, figs. 3, 15, 16, 21. Pennsylvanian, Iowa.
——— *tunetana* H. Douvillé, **299,** 76, pl. 1, figs. 1–8. Permian, Tunisia.
——— ——— H. Douvillé, 1934, var. *elongata* H. Douvillé, p. 77, pl. 1, figs. 9, 10. Permian, Tunisia. (Preoccupied by *Fusulina elongata* Shumard, 1858.)
Fusulinella iowensis Thompson, **299,** 296, pl. 20, figs. 28–30. Pennsylvanian, Iowa.
——— *librovitchii* Doutkevitch, **84,** 43, 81, pl. 5, figs. 1–5. Carboniferous, Ural Mountains, U.S.S.R.
——— *uralica* Doutkevitch, **84,** 47, 81, pl. 5, figs. 6–14. (Not *Fusulina uralica* Krotow, 1888.) Carboniferous, Moscovian, Ural Mountains, U.S.S.R.
——— ——— Doutkevitch, 1934, var. *inflata* Doutkevitch, **84,** 47, 81, pl. 5, fig. 15. Carboniferous, Moscovian, Ural Mountains, U.S.S.R. (Preoccupied by *Fusulinella inflata* Colani, 1924.)
——— ——— Doutkevitch, 1934, var. *longa* Doutkevitch, **84,** 47, 81, pl. 5, figs. Carboniferous, Moscovian, Ural Mountains, U.S.S.R.
——— *usvae* Doutkevitch, 1932, *Oil Geol. Inst., Trans.*, ser. A, fasc. 30, pp. 1–72 (description without figures). Doutkevitch, **84,** 53, 88, pl. 6, figs. 1–11. Carboniferous, Uralian, Ural Mountains, U.S.S.R.

Gallowaiina n. gen., Chen, **39,** 237. Fam. Fusulinidae. Genotype: *G. meitiensis* Chen, 1934. (Preoccupied by **Gallowayina** Ellis, 1932.) Middle and Upper Permian, China.
——— *meitiensis* Chen, **39,** 238, pl. 1, figs. 1–10. Middle and Upper Permian, southern China.
——— ———Chen, 1934, var. *evoluta* Chen, **39,** 239, pl. 1, figs. 11–14. Middle and Upper Permian, southern China.
Gaudryina deformis Earland, **89,** 120, pl. 5, figs. 37–40. Recent, Antarctic.
——— *minuta* Earland, **89,** 121, pl. 5, figs. 45, 46. Recent, Antarctic.
——— *pauperata* Earland, **89,** 121, pl. 5, figs. 47–49. Recent, Antarctic.
Globigerina kochi Caudri, **32,** 144. (For *Globigerina* sp. R. Koch, 1923, *Eclogae geol. Helvetiae*, vol. 18, p. 355, text fig. 8.) Lower Miocene, Tertiary f, Soemba, D.E.I.
——— *megastoma* Earland, **89,** 177, pl. 8, figs. 9–12. Recent, Antarctic.
——— *tricamerata* Tolmachoff, **303,** 324, pl. 41, fig. 21. [For *Globigerina bulloides* d'Orbigny, 1826, var. *triloba* H. B. Brady, 1884, *Challenger Rep.*, p. 595, pl. 81, figs. 2, 3; for the same species in Hanzawa, 1931, *Tôhôku Imp. Univ., Sci. Rep.*, (2), vol. 12, no. 2 a, p. 182, pl. 29, fig. 12; and for *Sphaeroidina? peruviana* Berry, 1932, *Eclogae geol. Helvetiae*, vol. 25, p. 29, pl. 2, fig. 4.] Miocene, Colombia, South America.
Globorotalia cushmani Morrow, **202,** 199, pl. 31, figs. 2, 4. Upper Cretaceous, Kansas.
——— *dehiscens* Chapman, Parr and Collins, **37,** p. 569, pl. 11, fig. 36. Oligocene, Victoria, Australia.
——— *greenhornensis* Morrow, **202,** p. 199, pl. 31, fig. 1. Upper Cretaceous, Kansas.
——— *menardii* (d'Orbigny, 1826), var. *fijiensis* Cushman, **58,** 136, p. 17, fig. 5. Late Tertiary. Vitilevu, Fiji.
——— ? *multiloculata* Morrow, **202,** 200, pl. 31, figs. 3, 5. Upper Cretaceous, Kansas.
——— *subconica* Morrow, **202,** 200, pl. 30, figs. 11, 18. Upper Cretaceous, Kansas.
Globulina, see *Polymorphina*.
Gümbelina cubensis D. K. Palmer, **220,** 74, text figs. 1–6. Upper Eocene and lower Oligocene, Cuba.
Gümbelitria (?) *vivans* Cushman, **56,** 105, pl. 13, figs. 9, 10. Recent, off New Guinea.
Gyroidina sp. Tolmachoff, **303,** 312, pl. 40, figs. 38–40. Miocene, Colombia, South America.

Halkyardia bartrumi Parr, **228,** 144, pl. 20, figs. 3–6, text figs. 1–3. Probably Middle Tertiary, New Zealand.
Hantkenina danvillensis Howe and Wallace, **142,** 37, pl. 5, figs. 14, 17. Upper Eocene, Jackson formation, Louisiana.
——— *trituberculata* Morrow, **202,** 195, pl. 29, figs. 24, 26–28. Upper Cretaceous, Kansas.
Haplophragmium sp. Eichenberg, **90,** 151, pl. 12, fig. 14. Lower Cretaceous, Hauterivian, Germany.
——— sp. (? n. sp.) Eichenberg, **90,** 151, pl. 17, fig. 2. Lower Cretaceous, Hauterivian, Germany.
Haplophragmoides quadratus Earland, **89,** 88, pl. 3, figs. 7, 8. Recent, Antarctic.
Hastigerinella simplex Morrow, **202,** 198, pl. 30, fig. 6. Upper Cretaceous, Kansas.
Heronallenia gemmata Earland, **89,** 182, pl. 8, figs. 26–29. Recent, Antarctic.
Heterostegina sp. Flandrin, **96,** 261, pl. 16, fig. 19. Upper Eocene, Algeria.
Hyperammina tubulosa Earland, **89,** 75, pl. 2, fig. 21. Recent, Antarctic.

Isolepidina? sp. Flandrin, **96,** 266, pl. 16, fig. 7; text fig. 7. Upper Eocene, Algeria.

Lagena basireticulata Earland, **89,** 143, pl. 6, figs. 39, 40. Recent, Antarctic.
——— *clowesiana* Earland, **89,** 145, pl. 6, figs. 41, 42. [For *Lagena semicostata* Sidebottom, 1912 (not Seguenza) *Queckett Micr. Club, Jour.* (2), vol. 11, p. 427, pl. 21, fig. 13.] Recent, Antarctic.
——— *deaconi* Earland, **89,** 146, pl. 6, figs. 48, 49. Recent, Antarctic.
——— *glans* Earland, **89,** 149, pl. 6, figs. 50, 51. Recent, Antarctic.
——— *globosa* (Montagu, 1803) var. *setosa* Earland, **89,** 150, pl. 6, fig. 52. [For *Lagena longispina* H. B. Brady, 1881, *Micr. Sci., Quart. Jour.*, vol. 21, p. 61, and for the same species in H. B. Brady, 1884, *Challenger Rep.*, p. 454, pl. 56, figs. 33–35 (not fig. 36; not pl. 59, figs. 13, 14).] Recent, Drake Street, Antarctic.
——— *guntheri* Earland, **89,** 151, pl. 6, figs. 53, 54. Recent, Antarctic.
——— *heronalleni* Earland, **89,** 152, pl. 6, figs. 55–57. [For *Lagena striatopunctata* (part) Heron-Allen and Earland, 1922, *Brit. Antarctic "Terra Nova" Expedition*, p. 149, pl. 6, figs. 5, 19.] Recent, Antarctic.
——— *johni* Earland, **89,** 153, pl. 6, figs. 61–63. Recent, Antarctic.
——— *lagenoides* (Williamson, 1858) var. *debilis* Earland, **89,** 154, pl. 7, fig. 1. (For *Lagena lagenoides* Sidebottom, 1912, *Queckett Micr. Club, Jour.*, (2), vol. 11, p. 413, pl. 18, fig. 29, and for *Lagena lagenoides* (part) Cushman, 1932, *U. S. Nat. Mus., Bull.* 161, pt. 2, p. 24, pl. 6, fig. 3 (only).] Recent, Antarctic.
——— *marginata* (Walker and Boys, 1784) var. *spinifera* Earland, **89,** 156, pl. 7, figs. 3, 4. [For *Lagena acuta* H. B. Brady, 1884 (not Reuss, 1862), *Challenger Rep.*, p. 474, pl. 59, fig. 6; for *Lagena sacculus* Cushman, 1913 (not Fornasini), *U. S. Nat. Mus., Bull.* 71, pt. 3, p. 8, pl. 3, figs. 1–3, and for *Lagena marginata* Sidebottom, 1912,

Queckett Micr. Club, Jour. (2), vol. 11, p. 407, pl. 18. figs. 4, 5.] Recent, Antarctic. (Preoccupied by *L. aspera* Reuss, 1862, var. *spinifera* Chapman, 1895.)

——— *palliolata* Earland, **89,** 158, pl. 7, figs. 5, 6. Recent, Antarctic.

——— *pseudauriculata* Earland, **89,** 158, pl. 7, figs. 7, 8. Recent, Antarctic.

——— *quadrilatera* Earland, **89,** 159, pl. 7, figs. 10, 11. [For *Lagena quadrangularis* Heron-Allen and Earland, 1922 (not H. B. Brady, 1884), *Brit. Antarctic "Terra Nova" Expedition*, p. 160, no. 353.] Recent, Antarctic.

——— *quadrilatera* Earland, 1934, var. *striatula* Earland, **89,** 160, pl. 7, fig. 9. Recent Antarctic. (Preoccupied by *L. sublagenoides* Cushman, 1913, var. *striatula* Cushman, 1913.)

——— *semilineata* J. Wright, 1886, var. *spinigera* Earland, **89,** 161, pl. 7, fig. 21. [For *Lagena semilineata* Sidebottom, 1913, *Queckett Micr. Club, Jour.*, (2), vol. 12, p. 173, pl. 15, fig. 27.] Recent, Antarctic. (Preoccupied by *L. bicarinata* (Terquem, 1882) var. *spinigera* Heron-Allen and Earland, 1922, and by *L. reniformis* Sidebottom, 1913, var. *spinigera* Sidebottom, 1913.)

——— *sidebottomi* Earland, **89,** 161, pl. 7, fig. 23. (For *Lagena* "intermediate form resembling *L. crenata* and *L. semistriata*" H. B. Brady, 1884, *Challenger Rep.*, pl. 57, fig. 20.) Recent, Antarctic.

——— sp. Eichenberg, **90,** 182, pl. 12, fig. 13. Lower Cretaceous Hauterivian, Germany.

Lenticulina colombiana Tolmachoff, **303,** 300, pl. 40. figs. 14, 15. Miocene, Colombia, South America.

——— *lens* Tolmachoff, **303,** 300, pl. 40, figs. 16, 17. Miocene, Colombia, South America.

——— *kansasensis* Morrow, **202,** 189, pl. 30, fig. 23. Upper Cretaceous, Kansas.

——— sp. Eichenberg, **90,** 158, pl. 13, fig. 5. Lower Cretaceous, Hauterivian, Germany.

——— ? sp. Flandrin, **96,** 266, pl. 16, figs. 17, 18. Upper Eocene, Algeria.

——— *sublaevis* Morrow, **202,** 189, pl. 30, figs. 14, 20. Upper Cretaceous, Kansas.

——— see also *Cristellaria.*

Lepidocyclina (*Lepidocyclina*) *ariana* Cole and Ponton, **44,** 142, pl. 2, figs. 1–5. Eocene, Florida. (Not *L. ariena* Berry, 1932.)

——— (*Eulepidina*) *cufraica* Silvestri, **275,** 23, pl. 2, figs. 14, 15; pl. 3, figs. 9, 10. [For *Lepidocyclina* sp. Nuttall, 1926, *Annals and Mag. Nat. Hist.* (9), vol. 17, p. 336, text fig. 2; pl. 13, figs. 7–10.] Oligocene, Sirtica, North Africa.

——— (*Eulepidina*) *dilatata* (Michelotti, 1861) var. *laddi* Whipple, **317,** 148, pl. 22, figs. 2, 3. Miocene, Fiji Islands.

———*gigas* Cushman, 1919, var. *duncanensis* Cole. **42,** 27, pl. 3, fig. 16; pl. 4, fig. 1. (For *Lepidocyclina gigas* Vaughan var., 1928, *Jour. Paleontology*, vol. 1, p. 295.) Oligocene, Florida.

——— sp. undet. *1*, Henrici, **131,** 50, pl. 2, fig. 19; pl. 4, fig. 10. Lower Miocene, Aquitanian, Timor, D.E.I.

——— sp. undet. *2*, Henrici, **131,** 51, pl. 4, fig. 9. Lower Miocene, Aquitanian, Timor, D.E.I.

——— sp. undet. *3*, Henrici, **131,** 51, pl. 4, fig. 5. Lower Miocene, Aquitanian, Timor, D.E.I.

——— sp. undet. *4*, Henrici, **131,** 51, pl. 2, fig. 20. Lower Miocene, Aquitanian, Timor, D.E.I.

——— sp. undet., Whipple, **317,** 146, pl. 21, fig. 6. Miocene, Fiji Islands.

——— (*Cyclolepidina*) *suvaensis* Whipple, **317,** 145, pl. 20, figs. 1–8, text fig. 11 b. Miocene, Fiji Islands.

——— (*Eulepidina*) *tjendanensis* Caudri, **32,** 101, pl. 3, figs. 5–7. Lower Miocene, Tertiary d, Soemba, D.E.I.

——— see also *Cyclolepidina*, *Eulepidina* and *Isolepidina.*

Lingulina davidi Chapman, Howchin and Parr, **36,** 185. [For *Bulimina affinis* Chapman and Howchin, 1905 (not d'Orbigny, 1839), *Geol. Survey New South Wales, Pal. Mem.* no. 14, p. 14, pl. 2, fig. 7.] Middle Permian, New South Wales, Australia.

Loftusinae n. subfam., Silvestri, *1932, Riv. italiana paleontologia*, vol. 38, p. 94. New subfamily of Lituolidae. [Includes the genera *Pseudocyclammina*, Yabe and Hanzawa, 1926, *Cyclammina* H. B. Brady, 1876, and *Loftusia* H. B. Brady, 1869.)

Margulina (misprint for *Marginulina*) *blanckenhorni* Brotzen, **27,** 43, pl. 1, fig. *d.* Upper Senonian-Danian, Palestine.

——— (misprint for *Marginulina*) *nothi* Brotzen, **27,** 42, not figured. Upper Senonian-Danian, Palestine.

——— (misprint for *Marginulina*) *rangei* Brotzen, **27,** 43, pl. 1, fig. *c.* Upper Senonian-Danian, Palestine

Marginulina sp. Eichenberg, **90,** 160, pl. 10, fig. 8. Lower Cretaceous, Hauterivian, Germany.

——— sp. Eichenberg, **90,** 161, pl. 11, fig. 19. Lower Cretacous, Hauterivian, Germany.

——— sp. (n. sp.?) Eichenberg, **90,** 160, pl. 10, fig. 12. Lower Cretaceous, Hauterivian, Germany.

? *Meandropsina rutteni* D. K. Palmer, **221,** 252, pl. 12, fig. 2; text figs. 15, 15 A. Uppermost Cretaceous, Santa Clara Province, Cuba.

Miliolina alti Brotzen, **27,** 55, pl. 4, fig. *c.* Upper Senonian-Danian, Palestine.

Miogypsina sp. undet., Henrici, **131,** 51, text fig. 25. Miocene, Aquitanian, Timor, D.E.I.

Miscellanea n. gen., Pfender, **231,** 80. Family not given. Genotype: *Siderolites miscella*

(d'Archiac and Haime, 1853, *Nummulites*). Uppermost Cretaceous and base Tertiary, Danian to Montian, India, Tibet, Anatolia, Syria, Madagascar, Pyrenees. (See also Pfender, **233,** 231, text fig. 1, type figure.)

Neoschwagerina craticulifera (Schwager, 1883) var. *haydeni* Doutkevitch, **83,** 94, pl. 2, figs. 6–8; pl. 3, figs. 1, 2. Permian, eastern Pamir.

——— *globosa* Yabe, 1906, race *punica* H. Douvillé, **86,** 81, pl. 2, figs. 4–11; pl. 3, figs. 1–3. Permian, Tunisia.

——— ——— Yabe *subaequalis* H. Douvillé, **86,** 79, pl. 2, figs. 2–4. Permian, Tunisia.

——— *syrtalis* H. Douvillé, **86,** 83, pl. 3, figs. 4–12. Permian, Tunisia.

Nodogenerina spinata Cushman, **58,** 123, pl. 14, fig. 14. Late Tertiary, Vitilevu, Fiji Islands.

Nodosarella n. sp., Morrow, **202,** p. 197, pl. 29, figs. 2, 3. Upper Cretaceous, Kansas.

Nodosaria acuta Eichenberg, **90,** 171, pl. 11, fig. 4. (Preoccupied by *Dentalina acuta* d'Orbigny, 1839). Lower Cretaceous, Hauterivian, Germany.

——— *alternistriata* Morrow, **202,** 190, pl. 29, fig. 1. Upper Cretaceous, Kansas.

——— *bartschi* Thalmann, **291,** 381. [For *Nautilus* (*Orthoceras*) *radicula* Batsch, 1791, in Cushman, 1931, *Cushman Lab. Foram. Research, Contr.*, vol. 7, p. 63, pl. 9, fig. 5.] Recent, Adriatic.

——— *communis* d'Orbigny, 1826, var. *larva* Earland, **89,** 167, pl. 7, figs. 40, 41. Recent, Antarctic. (This variety is preoccupied by *Nodosaria larva* Carsey, 1926).

——— *schöndorfi* Eichenberg, **90,** 173, p. 14, fig. 2. Lower Cretaceous, Hauterivian, Germany.

——— sp. Eichenberg, **90,** 172, pl. 12, fig. 4. Lower Cretaceous, Hauterivian, Germany.

——— *spinosa* Eichenberg, **90,** 172, pl. 12, fig. 8. (Preoccupied by *Dentalina spinosa* d'Orbigny, 1846; *Nodosaria spinosa* Neugeboren, 1852; and *N. spinosa* Berry, 1928.) Lower Cretaceous, Hauterivian, Germany.

——— *tenuistriata* Eichenberg, **90,** 172, pl. 11, fig. 13. (Preoccupied by *Dentalina tenuistriata* Terquem, 1866; and *Nodosaria tenuistriata* Franke, 1925.) Lower Cretaceous, Hauterivian, Germany.

Nonion montereyanum Cushman and Galliher, **61,** 24, pl. 4, fig. 6. Miocene, Monterey shale, California.

——— ——— Cushman and Galliher, 1934, var. *carmeloensa* Cushman and Galliher, **61,** 24, pl. 4. fig. 7. Miocene, Monterey shale, California.

——— *pizarrensa* Berry, 1928, var. *multicameratum* Cushman and Kleinpell, **64,** 4, pl. 1, fig. 10. Miocene, Monterey shale, California.

Nummulites sp. (A) Flandrin, **96,** 258, pl. 14, figs. 8–11. Upper Eocene, Algeria.

——— see also *Camerina*.

Operculina bermudezi D. K. Palmer, **221,** 238, pl. 12, figs. 3, 6–9; text fig. 1. Upper Cretaceous, Havana province, Cuba.

——— *doncieuxi* Flandrin, **96,** 261, pl. 15, figs. 12, 13. Upper Eocene, Algeria. (This species is also mentioned as a *nomen nudum* in Flandrin, **95,** 84.)

——— sp. Hadley, **121,** 15 (119), pl. 2, figs. 5, 6. Upper Eocene, Cuba.

Operculinella cojimarensis D. K. Palmer, **221,** 259, pl. 15, figs. 1, 3, 4; text fig. 18. Upper Oligocene, Cuba.

——— *operculiniformis* (Tellini, 1888) var. *hungarica* Rozlozsnik, **251,** 50, 51, text figs. 1–4. Eocene, Priabonian, Hungary.

Orbitolininae n. subfam., Silvestri, *1932, Palaeontographia Italia*, vol. 32, (new ser. vol. 2), anno 1931, Siena 1932, p. 160. (Comprises the following genera: *Lituonella* Schlumberger, *Coskinolina* Stache, *Orbitolinopsis* Silvestri, *Dictyoconus* Blanckenhorn, *Cushmania* Silvestri, *Orbitolina* d'Orbigny, *Pseudorbitolina* H. Douvillé, and ? *Conulina* d'Orbigny.)

Orbitolinopsis sp. Fichter, **94,** 30, text fig. 5. Jurassic, Malm, Swiss Alps.

Orobias kueichihensis Chen, **38,** 15, pl. i, fig. 5. Carboniferous, southern China.

Orthocyclina moluccana Henrici, **131,** 49, pl. 3, fig. 8; pl. 4, fig. 11; text fig. 22. Middle Eocene, Lutetian, Timor, D.E.I.

——— sp. undet., Caudri, **32,** 99, pl. 3, figs. 2, 3. Lower Eocene, Tertiary a_2 and b, Soemba, D.E.I.

Palmerinella n. gen., Bermudez, **17,** 83. Fam. Anomalinidae. Genotype: *P. palmerae* Bermudez, 1934. Recent, Cuba.

——— *palmerae* Bermudez, **17,** 84, text figs. 1–3. Recent, Cuba.

Parafusulina chekiangensis Chen, **38,** 84, pl. 9, figs. 5, 6. Carboniferous, southern China.

——— *constricta* Chen, **38,** 88, pl. 11, fig. 1. Carboniferous, southern China.

——— *gracilis* Chen, **38,** 89, pl. 12, fig. 1. Carboniferous, southern China.

——— *lungtanensis* Chen, **38,** 85, pl. 12, fig. 7. Carboniferous, southern China.

——— *subextensa* Chen, **38,** 90, pl. 12, fig. 8. Carboniferous, southern China.

——— *undulata* Chen, **38,** 82, pl. 12, fig. 5. Carboniferous, southern China.

Pilulina arenacea Earland, **89,** 59, pl. 1, figs. 15–17. Recent, Antarctic.

Placopsilinella n. gen., Earland, **89,** 95. Fam. Lituolidae. Genotype: *P. aurantiaca* Earland, 1934. Recent, Antarctic.

——— *aurantiaca* Earland, **89,** 95, pl. 3, fig. 18. Recent, Antarctic.

Planularia sp. (?) Cushman, **58,** 110, pl. 11, fig. 5. Late Tertiary, Vitilevu, Fiji Islands.

——— sp. (?) Cushman and Kleinpell, **64,** 3, pl. 1, fig. 5. Miocene, California.

——— sp. Hadley, **121,** 13 (117), pl. 5, fig. 8. Tertiary, Cuba.

Planulina bradii Tolmachoff, **303,** 333, pl. 41, figs. 32–34. [For *Truncatulina wuellerstorfi* H. B. Brady, 1884, (not Schwager, 1866, *Anomalina*) *Challenger Rep.*, p. 662, pl. 93, figs. 8 *a–c.*, and for the same species in Cushman, 1931, *U. S. Nat. Mus., Bull.* 104, pt. 8, p. 110, pl. 19, fig. 5.] Miocene, Colombia, South America.

——— *elegans* Tolmachoff, **303,** 334, pl. 41, figs. 35–37. Miocene, Colombia, South America. (Preoccupied by *P. elegans* Ehrenberg, 1849, 1854.)

——— *fijiensis* Cushman, **58,** 136, pl. 18, fig. 4. Late Tertiary, Vitilevu, Fiji Islands.

——— *kansasensis* Morrow, **202,** 201, pl. 30, figs. 2, 12, 15. Upper Cretaceous, Kansas.

——— *marialana* Hadley, **121,** 27 (131), pl. 4, figs. 4–6. Oligocene, Cuba.

——— *matanzasensis* Hadley, **121,** 27 (131), pl. 4, figs. 1–3. Oligocene, Cuba.

Plectofrondicularia karreri Oppl, **219,** 52, pl. 1, fig. 2. Miocene, Troppau, Czechoslovakia.

——— *tenera* Oppl, **219,** 52, pl. 1, fig. 3. Miocene, Troppau, Czechoslovakia.

Pleurostomella nitida Morrow, **202,** 196, pl. 30, fig. 22. Upper Cretaceous, Kansas.

Polymorphina (*Globulina*) *scoresbyana* Earland, **89,** p. 174, pl. 8, figs. 6–8.

——— sp. Eichenberg, **90,** 183, pl. 14, fig. 3. Lower Cretaceous, Hauterivian, Germany.

Pseudobulimina n. gen., Earland, **89,** 133. Fam. Buliminidae, subfam. Cassidulininae. Genotype: *Bulimina chapmani* Heron-Allen and Earland, 1922. Recent, Antarctic.

Pseudofusulina bicornis Chen, **38,** 50, pl. 5, fig. 18. Carboniferous, southern China.

——— *chihsiaensis* (Lee, 1931) var. *brevis* Chen, **38,** 77, pl. 9, fig. 9. Carboniferous, southern China.

——— ——— (Lee, 1931) var. *fragilis* Chen, **38,** 76, pl. 9, fig. 11. Carboniferous, southern China.

——— ——— (Lee, 1931) var. *regularis* Chen, **38,** 75, pl. 9, fig. 10. Carboniferous, southern China.

——— *cushmani* Chen, **38,** 72, pl. 6, figs. 4–6. Carboniferous, southern China.

——— *gallowayi* Chen, **38,** 70, pl. 6, figs. 7, 8. Carboniferous, southern China.

——— *hutienensis* Chen, **38,** 56, pl. 5, fig. 2. Carboniferous, southern China.

——— *kiangsuensis* Chen, **38,** 73, pl. 12, fig. 6. Carboniferous, southern China.

——— *maoshanensis* Chen, **38,** 64, pl. 2, figs. 13, 14. Carboniferous, southern China.

Pseudofusulina mutabilis Chen, **40,** 45, pl. 8, figs. 1, 2. Lower Permian, Maping limestone, Kwangsi, China.

——— *paraprisca* Chen, **38,** 59, pl. 4, figs. 1, 14. Carboniferous, southern China.

——— *pseudochihsiaensis* Chen, **38,** 77, pl. 9, fig. 9. Carboniferous, southern China.

——— *pseudoexilis* Chen, **38,** 66, pl. 2, fig. 3. Carboniferous, southern China.

——— *robusta* Chen, **38,** 61, pl. 4, fig. 10. Carboniferous, southern China.

——— *tenuis* Chen, **38,** 71, pl. 4, fig. 9. Carboniferous, southern China.

——— *tschernyschewi* (Schellwien, 1908) var. *ellipsoidalis* Chen, **38,** 55, pl. 10, figs. 13, 14. Carboniferous, southern China.

——— ——— (Schellwien, 1908) var. *fusiformis* Chen, **38,** 54, pl. 10, fig. 12. Carboniferous, southern China.

Pseudofusulininae n. subfam., Doutkevitch, **83,** 53. Permian.

Pseudofusulininae n. tribe of the subfamily Pseudofusulininae, Doutkevitch, **83,** 53 ff. Permian.

Pullenia n. sp. undet., Schnetzer, **265,** 277, text fig. 6. Upper Cretaceous, Germany.

Pulvina (misprint for *Pulvinulina*) *guthei* Brotzen, **27,** 65, pl. 2, fig. *d.* Upper Cretaceous, Campanian to Danian, Palestine.

Pulvinulinella capitanensis Cushman and Kleinpell, **64,** 16, pl. 3, fig. 3. Miocene, California.

——— (?) *tenuimarginata* Chapman, Parr and Collins, **37,** 565, pl. 9, fig. 19. Oligocene, Victoria, Australia.

Pyropilus n. gen., Cushman, **54,** 100, Fam. Cymbaloporidae. Genotype: *P. rotundatus* Cushman, 1934. Recent, Pacific.

——— *rotundatus* Cushman, **54,** 100, pl. 13, figs. 1, 2. Recent, off Rangiroa, Pacific.

Quasifusulina n. gen., Chen, **38,** 92. Fam. Fusulinidae. Genotype: *Fusulina longissimia* v. Möller, 1877. Carboniferous, southern China.

Quinqueloculina sp. ? Barbat and Johnson, **11,** 16, pl. 1, fig. 11. Upper Miocene, California.

——— *subquadrata* Tolmachoff, **303,** 297, pl. 42, figs. 30, 31. Miocene, Colombia, South America. (This species is misnamed, as it may cause confusion with *Quinqueloculina subquadra* Hada, 1931.)

Recurvoides n. gen., Earland, **89,** 90, Fam. Lituolidae. Genotype: *R. contortus* Earland, 1934. Recent, Antarctic.

——— *contortus* Earland, **89,** 91, pl. 10, figs. 7–19. [For *Haplophragmium scitulum* (part) Flint, 1899, *U. S. Nat. Mus., Rept. for 1899*, p. 276, pl. 20, fig. 2.] Recent, Antarctic.

Reophax bicameratus Earland, **89,** 83, pl. 2, fig. 27. Recent, Antarctic.

Reophax micaceus Earland, **89,** 82, pl. 2, figs. 37–40. Recent, Antarctic.
Robulus branneri Cushman and Kleinpell, **64,** 2, pl. 1, fig. 4. Miocene, Monterey shale, California.
——— *lenticularis* Tolmachoff, **303,** 302, pl. 40, figs. 20, 21. Miocene, Colombia, South America. (This species should not be confused with *Cristellaria lenticula* Reuss, 1850, or *Robulina lenticula* Stache, 1864.)
——— sp. Eichenberg, **90,** 155, pl. 13, fig. 7. Lower Cretaceous, Hauterivian, Germany.
——— sp. Eichenberg, **90,** 156, pl. 17, fig. 8. Lower Cretaceous, Hauterivian, Germany.
——— sp. (n. sp. ?) Eichenberg, **90,** 155, pl. 13, fig. 4. Lower Cretaceous, Hauterivian, Germany.
Rotalia alveiformis Thalmann, **298,** 438, pl. 11, figs. 4, 5. Plio-Pleistocene, Java, D.E.I.
——— *beccarii* (Linnaeus, 1767) var. *sobrina* Shupack, **270,** 6, fig. 4. [For *R. beccarii* (Linnaeus) var. *parkinsoniana* Cushman, 1930 (not *R. parkinsoniana* d'Orbigny, 1839), *Cushman Lab. Foram. Res., Contr.*, vol. 6, p. 100, pl. 13, fig. 14, and for *R. beccarii* (Linnaeus) var. *parkinsoniana* Cole, 1931, *Florida Geol. Survey, Bull.* 6, p. 49, pl. 3, figs. 5, 6.]
——— *catilliformis* Thalmann, **298,** 437, pl. 11, figs. 1–3, Plio-Pleistocene, Java, D.E.I.
——— *concavata* Brotzen, **27,** 66, pl. 3, fig. *b*. Upper Cretaceous, Campanian to Santonian, Palestine.
——— *elevata* Brotzen, **27,** 66, pl. 3, fig. *c*. Upper Cretaceous, Campanian-Santonian, Palestine.
——— *elphidioides* Caudri, **32,** 148, pl. 5, figs. 13, 17. Miocene, Soemba, D.E.I.
——— *howchini* Chapman, Parr and Collins, **37,** 566, pl. 9, fig. 20. [For *Rotalia papillosa* H. B. Brady, 1884, var. *compressiuscula* Howchin, 1889 (not H. B. Brady, 1884), *Royal Soc. South Australia, Trans.*, vol. 12, p. 15, and for *Rotalia reticulata* Heron-Allen and Earland, 1924 (not Cushman, 1918), *Roy. Micr. Soc., Jour.*, p. 181, pl. 14, figs. 114–116.] Oligocene, Victoria, Australia.

Saccammina sp. Eichenberg, **90,** 151, pl. 15, fig. 7. Lower Cretaceous, Hauterivian, Germany.
Schubertella pseudoobscura Chen, **38,** 16, pl. 1, figs. 1, 2. Carboniferous, southern China.
——— *regularis* Chen, **38,** 17, pl. 1, figs. 3, 4. Carboniferous, southern China.
Schwagerina fusulinoides Schellwien, 1892, var. *exilis* Chen, **38,** 95, pl. 15, figs. 6, 8. Carboniferous, southern China.
——— sp. Chen, **38,** 97, pl. 15, fig. 5. Carboniferous, southern China.
Siderolina hamata Brotzen, **27,** 68, pl. 3, fig. *a*. Upper Cretaceous, Upper Senonian, Palestine.

Silicotextulina n. gen., Deflandre, **77,** 1446. No family given. Genotype: *S. diatomitarum* Deflandre, 1934. Miocene, California.
———*diatomitarum* Deflandre, **77,** 1447. No figures given. Miocene, California (*see* also Deflandre, **76,** p. 109 ff).
Siphogenerina nodifera Cushman and Kleinpell, **64,** 13, pl. 2, figs. 15, 16. Miocene, California.
——— *pseudococoaensis* Cushman and Kleinpell, **64,** 13, pl. 2, fig. 14. Miocene, California.
——— *tenua* Cushman and Kleinpell, **64,** 13, pl. 2, fig. 13. Miocene, California (*tenua* perhaps misprint for *tenuis*).
Siphonina antioguiensis Tolmachoff, **303,** 316, pl. 41, figs. 13–15; pl. 42, figs. 28, 29. Miocene, Colombia, South America.
——— *chocoiensis* Tolmachoff, **303,** 317, pl. 41, figs. 16–18. Miocene, Colombia, South America.
Sorosphaera socialis Earland, **89,** 61, pl. 1, figs. 22–24; pl. 2, fig. 1. Recent, Antarctic.
Spirillina pectinimarginata Chapman, Parr and Collins, **37,** 558, pl. 8, fig. 3. Oligocene, Victoria, Australia.
? *Spiroclypeus* sp. undet., Henrici, **131,** 35, pl. 4, fig. 6. Lower Miocene, Aquitanian, Timor, D.E.I.
Spirolocammina n. gen., Earland, **89,** 109. Fam. Lituolidae, subfam. Silicininae. Genotype: *S. tenuis* Earland, 1934. Recent, Antarctic.
——— *tenuis* Earland, **89,** 109, pl. 4, figs. 13–16. Recent, Antarctic.
Spiroloculina pusilla Earland, **89,** 47, pl. 1, figs. 3, 4. [For *Spiroloculina tenuis* H. B. Brady, 1884, (not Czjzek, 1848, *Quinqueloculina*) *Challenger Rep.*, pl. 10, fig. 10 (? also fig. 9), and for *Spiroloculina tenuissima* Cushman, 1921 (not Reuss, 1867).] Recent, Antarctic.
Spiroplectammina filiformis Earland, **89,** 112, pl. 4, figs. 30–32. Recent, Antarctic.
——— *subcylindrica* Earland, **89,** 112, pl. 4, figs. 33–35. Recent, Antarctic.
Spiroplectella n. gen., Earland, **89,** 113. Fam. Textulariidae. Genotype: *S. cylindroides* Earland, 1934. Recent, Antarctic.
———*cylindroides* Earland, **89,** 114, pl. 4, figs. 36–38. Recent, Antarctic.
Spiroplectoides californica Cushman and Campbell, **59,** 70, pl. 9, figs. 15–17. Upper Cretaceous, California.
Staffella dagmarae Doutkevitch, **84,** 22, 68, pl. 3, figs. 11–15. Carboniferous, Ural Mountains, U.R.S.S.
——— *ivanovi* Doutkevitch, **84,** 34, 76, pl. 4, figs. 9–11. Carboniferous, Ural Mountains, U.S.S.R.
——— *leei* Doutkevitch, **84,** 27, 71, pl. 4, figs. 1, 2. Carboniferous, Ural Mountains, U.S.S.R.

Staffella mathildae Doutkevitch, **84,** 37, 78, pl. 4, figs. 12–16. Carboniferous, Ural Mountains, U.S.S.R.

——— *paradoxa* Doutkevitch, **84,** 14, 65, pl. 1, figs. 9, 10; pl. 2, figs. 1–10. Carboniferous, Ural Mountains, U.S.S.R.

——— *preobrajenskyi* Doutkevitch, **84,** 30, 73, pl. 4, figs. 3–8. Carboniferous, Uralian, Ural Mountains, U.S.S.R.

——— *pseudosphaeroidea* Doutkevitch, **84,** 17, 66, pl. 3, figs. 2–10. Carboniferous, Uralian, Ural Mountains, U.S.S.R.

Technitella bradyi Earland, **89,** 65, pl. 2, figs. 7–9. [For *Technitella melo* H. B. Brady, 1884 (not Norman, 1878), *Challenger Rep.*, p. 246, pl. 25, fig. 7.] Recent, Antarctic.

Textularia paupercula Earland, **89,** 114, pl. 5, figs. 27–29. Recent Antarctic.

——— *rangei* Brotzen, **27,** 56, pl. 1. fig. *a.* (in text, fig. *b.* on pl. 1). Upper Cretaceous, Santonian to Emscherian, Palestine.

——— sp. Eichenberg, **90,** 152, pl. 12, fig. 16. Lower Cretaceous, Hauterivian, Germany.

——— sp. (?) Cushman, **58,** 105, pl. 10, fig. 5. Lower Tertiary, Vitilevu, Fiji Islands.

——— sp. Hadley, **121,** 7 (111), pl. 1, fig. 1. Tertiary, Cuba.

Thurammina corrugata Earland, **89,** 70, pl. 2, figs. 15–18. Recent, Antarctic.

——— *spumosa* Earland, **89,** 71, pl. 9, figs. 14–19. Recent, Antarctic.

Torreina n. gen., D. K. Palmer, **221,** 237. Fam. Orbitoididae. Subfam. Omphalocyclininae. Genoholotype: *T. torrei* Palmer, 1934. Upper Cretaceous, Cuba.

——— *torrei* Palmer, **221,** 237, pl. 12, figs. 1, 4. Cretaceous, Matanzas province, Cuba.

Tretomphalus atlanticus Cushman, **54,** 86, pl. 11, fig. 3; pl. 12, fig. 7. [For *Cymbalopora* (*Tretomphalus*) *bulloides* (part) H. B. Brady, 1884, *Challenger Rep.*, p. 638, pl. 102, figs. 10, 11 (not figs. 7–9, 12) (not d'Orbigny, 1839).] Recent, off Florida, U. S. A.

——— *clarus* Cushman, **54,** 99, pl. 11, fig. 6; pl. 12, figs. 16, 17. Recent, off Ladrone Islands, Pacific.

——— *grandis* Cushman, **54,** 95, pl. 11, fig. 10; pl. 12, figs. 23, 24. Recent, off Rangiroa, Pacific.

——— *pacificus* Cushman, **54,** 93, pl. 11, fig. 7; pl. 12, figs. 8–12. Recent, off Chile, South Pacific.

Triloculina inusitata Cushman and Garrett, **62,** 66, pl. 9, figs. 8–10. Eocene, Louisiana.

——— *mirifica* Cushman and Garrett, **62,** 65, pl. 9, figs. 11–14. Eocene, Louisiana.

——— *paulocostata* Cushman and Garrett, **62,** 69, pl. 9, figs. 6, 7. Eocene, Louisiana.

Triticites bellus Chen, **38,** 47, pl. 4, figs. 12, 13, 15. Carboniferous, southern China.

——— *chui* Chen, **38,** 44, pl. 7, fig. 10; pl. 8, figs. 4, 5. Carboniferous, southern China.

——— ——— Chen, 1934, var. *robustata* Chen, **38,** 44, pl. 8, fig. 3. Carboniferous, southern China.

——— *delicatus* Chen, **38,** 44, pl. 2, figs. 15–17. Carboniferous, southern China.

——— *densimedius* Chen, **38,** 45, pl. 3, fig. 24. Carboniferous, southern China.

——— *huanglienhsiaensis* Chen, **38,** 28, pl. 3, fig. 22. Carboniferous, southern China.

——— *kiuyaoshanensis* Chen, **38,** 43, pl. 5, fig. 12. Carboniferous, southern China.

———*kuanshanensis* Chen, **38,** 41, pl. 7, fig. 16. Carboniferous, southern China.

——— *kueichihensis* Chen, **38,** 42, pl. 5, figs. 16, 17. Carboniferous, southern China.

——— *liuchowensis* Chen, **40,** 43, pl. 7, fig. 4. Lower Permian, Maping limestone, Kwangsi, China.

——— *nebraskensis* Thompson, **299,** 281, footnote 11. (For *Fusulina exigua* Schellwien and Staff, 1912, and for *Triticites exiguus* Dunbar and Condra, 1927, *Nebraska Geol. Survey, Bull.* 2, 2d ser., p. 111, pl. 8, figs. 5–11.) Paleozoic, U. S. A.

——— *neglectus* Newell, **213,** 422, pl. 52, fig. 2; pl. 53, fig. 1. Middle Pennsylvanian, Kansas.

——— *ordinatus* Chen, **38,** 38, pl. 7, figs. 5–7. Carboniferous, southern China.

——— *osagensis* Newell, **213,** 423, pl. 52, fig. 4; pl. 53, fig. 4. Middle Pennsylvanian, Oklahoma.

——— *ovoideus* Chen, **38,** 26, pl. 3, fig. 8. Carboniferous, southern China.

——— *pararegularis* Chen, **38,** 31, pl. 1, figs. 25, 26. Carboniferous, southern China.

——— *parvus* Chen, **38,** 23, pl. 1, figs. 10–14. Carboniferous, southern China.

——— *pseudosimplex*, Chen, **38,** 25, pl. 1, figs. 19, 20, Carboniferous, southern China.

——— *regularis* (Schellwien, 1898) var. *chinensis* Chen, **38,** 30, pl. 1, figs. 23, 24, 27. Carboniferous, southern China.

——— *samenkiangensis* Chen, **40,** 42, pl. 8, figs. 6, 7. Lower Permian, Maping limestone, Kwangsi, China.

——— *secalicus* (Say, 1823) var. *oryziformis* Newell, **213,** 424, pl. 52, fig. 3; pl. 53, fig. 3. Middle Pennsylvanian, Kansas.

——— *sinensis* Chen, **38,** 36, pl. 7, figs. 8, 12. Carboniferous, southern China.

——— *subrhomboides* Chen, **38,** 29, pl. 3, fig. 16. Carboniferous, southern China.

——— *tenuithecus* Chen, **38,** 49, pl. 3, fig. 13. Carboniferous, southern China.

——— *truncatus* Chen, **38,** 39, pl. 2, figs. 8–10. Carboniferous, southern China.

Trochammina alternans Earland, **89,** 103, pl. 3, figs. 24–27. Recent, Antarctic. (Preoccupied by *T. irregularis* (d'Orbigny, 1850), var. *alternans* Jones and Parker, 1860.)

——— *conica* Earland, **89,** 104, pl. 3, figs. 47–49. Recent, Antarctic.

Trochammina discorbis Earland, **89,** 104, pl. 3, figs. 28–31. Recent, Antarctic.
——— *frankei,* Eichenberg, **90,** 154, pl. 15, fig. 12. Lower Cretaceous, Hauterivian, Germany.
——— *grisea* Earland, **89,** 100, pl. 3, figs. 35–37. Recent, Antarctic.
Trochammina inconspicua Earland, **89,** 102, pl. 3, figs. 38–40. (For *Trochammina turbinata* Earland, 1933, *Discovery Rept.*, vol. 7, p. 86, no. 139.) Recent, Antarctic.
——— *rossensis* Warthin, **314,** 3, text figs. 1–3. Recent, Ross Sea, Antarctic.
——— *tricamerata* Earland, **89,** 103, pl. 3, figs. 50–52. Recent, Antarctic.
Tubulogenerina jacksonensis Howe, **141,** 420, pl. 51, fig. 8. Upper Eocene, Jackson formation, Louisiana.

Ungulatella capistra Cushman, **55,** 103, pl. 13, fig. 8. Recent, off Rangiroa, South Pacific.
——— *conoides* Cushman, **55,** 102, pl. 13, figs. 6, 7. Recent, off Rangiroa, South Pacific.
——— *peregrina* Cushman, **55,** 102, pl. 13, fig. 5. Recent, off Rangiroa, South Pacific.
Uvigerina canariensis d'Orbigny, 1839, var. *spinulosa* Hadley, **121,** 18 (122), pl. 2, fig. 17. Oligocene, Cuba.
——— *carmeloensis* Cushman and Kleinpell, **64,** 11, pl. 2, fig. 7. Miocene, Monterey shale, California.
——— *gardnerae* Cushman and Applin, 1926, var. *cubana* Hadley, **121,** 19 (123), pl. 2, fig. 12. Oligocene, Cuba.
——— *hootsi* Rankin, 1934, in Cushman and Kleinpell, **64,** 22, pl. 3, figs. 8, 9. Miocene, California.
——— *modeloensis* Cushman and Kleinpell, **64,** 12, pl. 2, fig. 8. Miocene, lower Modelo formation, California.
——— *segundoensis* Cushman and Galliher, **61,** 26, pl. 4, fig. 11. Miocene, Monterey shale, California.
——— *striatella* Brotzen, **27,** 54, pl. 2, fig. *a*. Upper Cretaceous, Senonian-Danian, Palestine. (This species is already preoccupied by Reuss, 1851.)
——— *subperegrina* Cushman and Kleinpell, **64,** 12, pl. 2, figs. 9–11. Miocene, California.
Uvigerinella californica Cushman, 1926, var. *gracilis* Cushman and Kleinpell, **64,** 11, pl. 2, fig. 6. Miocene, Monterey shale, California.

Vaginulina knighti Morrow, **202,** 191, pl. 29, fig. 23. Upper Cretaceous, Kansas.
——— *niobrarensis* Morrow, **202,** 191, pl. 29, fig. 8. Upper Cretaceous, Kansas.
——— n. sp., Eichenberg, **90,** 176, pl. 11, fig. 11; pl. 12, fig. 15. Lower Cretaceous, Hauterivian, Germany.
——— *pulchra* Eichenberg, **90,** 176, pl. 11, fig. 10. Lower Cretaceous, Hauterivian, Germany.
——— *rectilateralis* Morrow, **202,** 191, pl. 29, fig. 29. Upper Cretaceous, Kansas.
——— sp. Eichenberg, **90,** 177, pl. 14, fig. 6. Lower Cretaceous, Hauterivian, Germany.
——— *subcomarginata* Morrow, **202,** 192, pl. 29, fig. 21. Upper Cretaceous, Kansas.
——— *wageri* Eichenberg, **90,** 178, pl. 15, fig. 11. Lower Cretaceous, Hauterivian, Germany.
Valvulineria grandis Cushman and Galliher, **61,** 26, pl. 4, fig. 12. Miocene, Monterey shale, California.
——— *infrequens* Morrow, **202,** 197, pl. 30, fig. 3. Upper Cretaceous, Kansas.
——— *involuta* Cushman and Dusenbury, **60,** 63, pl. 8, fig. 12. Eocene, California.
——— *joaquinensis* Cushman and Kleinpell, **64,** 14, pl. 2, fig. 17. Miocene, California.
Vaughanina n. gen., D. K. Palmer, **221,** 240. Fam. probably Planorbulinidae. Genohlotype: *V. cubensis* Palmer, 1934. Upper Cretaceous, Cuba.
——— *cubensis* D. K. Palmer, **221,** 241, pl. 12, fig. 5; pl. 13, figs. 2, 4; text figs. 2, 3. Upper Cretaceous, Havana province, Cuba.
Verbeekina minor Chen, **38,** 102, pl. 16, fig. 2. Carboniferous, southern China.
Verbeekminae n. tribe, Doutkevitch, **84,** 53 ff. New tribe of Pseudofusulininae Doutkevitch, 1934. Permian.
Verneuilina fusiformis Tolmachoff, **303,** 291, pl. 40, figs. 4, 5. Miocene, Colombia, South America.
——— sp. Tolmachoff, **303,** 292, pl. 40, figs. 6, 7. Miocene, Colombia, South America.
——— *superba* Earland, **89,** 118, pl. 5, figs. 30–34. Recent, Antarctic.
Virgulina californiensis Cushman, 1925, var. *grandis* Cushman and Kleinpell, **64,** 9, pl. 1, figs. 15, 16. Miocene, Rodeo shale, California.
——— ——— Cushman, 1925, var. *ticensis* Cushman and Kleinpell, **64,** 10, pl. 1, fig. 17. Miocene, Tice shale, California.
——— *delmontensis* Cushman and Galliher, **61,** 25, pl. 4, fig. 9. Miocene, Monterey shale, California.
——— *subplana* Barbat and Johnson, **11,** 14, pl. 1, figs. 16, 17. Upper Miocene, California.
Vulvulina pachyheilus Hadley, **121,** 7 (111), pl. 1, figs. 2–4. Oligocene, Cuba.

Webinella farcta Earland, **89,** 67, pl. 10, figs. 1–6. Recent, Antarctic.
Wedekindellina dunbari Thompson, **299,** 285, pl. 20, figs. 3, 6, 15, 16, 20, 21. Pennsylvanian, Iowa.
——— *elfina* Thompson, **299,** 287, pl. 20, figs. 8, 10, 11, 18, 19. Pennsylvanian, Iowa.
——— *uniformis* Thompson, **299,** 289, pl. 20, figs. 4, 5, 14, 23.

NOMINA NUDA

The following *nomina nuda* were recorded in the literature of foraminifera for the year 1934:

Bradyina cribrostomata Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

Endothyra omphalota Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

Fusulina samarica Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

——— *ozawai* Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

Fusulinella pulchra Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

——— ——— var. *mesopachys* Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

Hyperammina vulgaris Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

——— *elegans* Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

Ovalveolina n. gen., Reichel, in Pfender, **234,** 473. Upper Cretaceous, France. Pfender figures *O. ovum* (d'Orbigny, 1847), on pl. 24, fig. 5.

Pulivina (misprint for *Pulvinulina*) *palestinensis* Brotzen, **27,** 72. Upper Cretaceous, Palestine.

Samarina n. gen., Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

——— *operculata* Rauser-Tschernoussowa, **245,** Carboniferous, Russia.

Schubertella n. gen., Rauser-Tschernoussowa, **245,** Carboniferous, Russia. (Preoccupied by Staff and Wedekind, 1910.)

Schwagerina tumida Licharew, **182,** 180. Lower Permian, Darwas, U.S.S.R.

Finally, the following forms, to which the trinomial nomenclature has been applied, mentioned in Pfender, 234, from the Cenomanian (Upper Cretaceous) of France, are also *nomina nuda: Praealveolina cretacea brevis* Reichel, *P. cretacea cretacea* Reichel, *P. cretacea lata* Reichel, *P. cretacea tenuis* Reichel, *P. iberica iberica* Reichel, *P. iberica pennensis* Reichel, and *P. simplex simplex* Reichel.

PALEONTOLOGICAL NOTES

NEW NAME FOR A MORRISON OSTRACODE GENUS

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In a recent paper on the fresh-water invertebrates of the Morrison formation in Wyoming (*Jour. Paleontology*, vol. 9, pp. 514–522, Sept. 1935), I described and named *Morrisonia*, a new genus of ostracodes. Dr. Paul H. Oehser of the Smithsonian Institute has pointed out that this name is preoccupied by *Morrisonia* Grote, 1874, a genus of living Lepidoptera. The new name *Theriosynoecum*, from Greek θηρ, monster, plus συνοικος, living with, is here proposed for the ostracode genus, in reference to its occurrence with the dinosaurs.

Additional collections during the summer of 1935 from my original locality have provided specimens of *Paracypris simplus* Roth, and of *Bairdiocypris celtiformis* Harper and Sutton. Harper and Sutton have recently described an ostracode faunule from the Morrison of the Black Hills. They suppress *Metacypris minnekahtensis* (Roth) as they consider it the female of *M. pahasapensis* (Roth). The latter species is distinguished by male characteristics and by nodosity of the carapace, although some females bear a few nodes. In some 35 specimens from Wyoming both male and female types are represented, but none show nodosity. This suggests that the nodose forms constitute a variety which did not occur in Wyoming. I have referred some Wyoming specimens to *Paracypris acuminata* Roth, which I believed to be a *Darwinula*, but since Roth clearly states that there is little valvular overlap in his species, it can not belong to that genus. The Wyoming specimens show strong overlap of the right valve and agree in every way with *Darwinula dakotensis* Harper and Sutton, except that the average specimen is somewhat more elongate than the figured specimens. The Wyoming locality yields abundant well preserved specimens of trochiliscids (referred to in earlier papers as *Chara* or as *Chara*-like algae), and these have been sent for study to Dr. Raymond E. Peck of the University of Missouri.

REVIEW

GEOLOGY OF THE TAMPICO REGION, by JOHN MUIR, to be issued as a special publication of the American Association of Petroleum Geologists. (A Preview)

Paleontologists and stratigraphers interested in Gulf Coast stratigraphy and correlation should find this comprehensive treatment of synchronous sediments in an adjoining basin of deposition distinctly enlightening and indispensable as a reference. Many new field observations by this meticulous worker are offered with conclusions both final and frankly tentative. Problems of stratigraphic nomenclature, of correlation, of structural relationships, and of paleogeographic history have been handled convincingly on the basis of an immense amount of data, many of which have been assembled from scattered shorter contributions and fitted into a unified structure founded largely upon the author's own extensive observations in this area. During many years of study of these problems, discussions with the pioneer geologists in Mexico have been carried on, old letters carrying valuable unpublished data have been studied, old notebooks have been gleaned, and the coöperation of many specialists in restricted branches have been enlisted; seemingly no relevant records have been missed. Salient and strategic published records have been extensively quoted and thereby have been rendered more valuable to the reader by fitting them into the present picture in their proper relationships, a highly important feature in such a work as this. Numerous illustrations, both photographs and maps, aid the reader toward a clear understanding of relationships. Extensive paleontologic lists, both from established type localities and from well-chosen new localities, offer convincing evidence of the validity of conclusions drawn. Even where the reader may not feel inclined to agree with conclusions offered, he can not help but find his problems distinctly clarified by the data lucidly presented for independent consideration.

The hitherto problematical age of the Tamesí (Velasco) formation is based on an immense amount of new investigation in the field, consisting of some subsurface study together with many new surface collections in well-established positions in the geologic section and based on a broad consideration of stratigraphic relationships over eastern Mexico. Significant evidence bearing on this complex problem is offered in faunal lists by localities, and the tentative conclusion of Danian age, or a position between Navarro (or Ripley) and Midway, will probably be found difficult to refute. The author recognizes the need of much more extensive field study before any dogmatic statement can be made.

Another tricky problem that has commanded much field study and consideration has been the age of the so-called "Alazán" formation, a name that has been applied both to uppermost Eocene strata and to lowermost Oligocene in this area. All points in stratigraphic and paleontologic "parliamentary law" have been carefully weighed, and all old records have been penetratingly investigated without prejudice. Because the type locality is obviously of rapidly changing topography due to a shifting river channel, it is uncertain just where the original Cummins' collections were made, and it was on the basis of these collections that Dumble assigned the name Alazan to uppermost Eocene strata. In the present outcrop sizable inclusions of Eocene strata are found reworked in the dominant Oligocene strata *in situ*. Such a complexity of conditions makes the name and type locality so unsuitable to stable stratigraphic work, that they have in this treatment been abandoned in favor of a new locality and a new name, Huasteca formation, for the lowest Oligocene unit. The name Chapapote is recognized for the uppermost Eocene unit.

As a contribution to stratigraphy, this book is conspicuous for its discriminating and penetrating observations.

HELEN JEANNE PLUMMER

SOCIETY RECORDS AND ACTIVITIES

SUMMARIZED MINUTES OF THE TENTH ANNUAL MEETING OF THE SOCIETY OF ECONOMIC PALEONTOLOGISTS AND MINERALOGISTS

President, W. H. Twenhofel, in the chair

Vice-President, U. S. Grant (absent)

Secretary-Treasurer, Gayle Scott

Editor, Raymond C. Moore.

The tenth annual meeting of the Society of Economic Paleontologists and Mineralogists was held in the Junior Ball Room of the Mayo Hotel, Tulsa, Oklahoma, Friday, March 20, 1936. The meeting was a part of the annual convention of the American Association of Petroleum Geologists.

President Twenhofel called the meeting to order at 9:00 A.M. and the following papers were read:

1. Additional Ostracodes from the Simpson and Arbuckle of Oklahoma, *R. W. Harris.*

2. A New Classification for Paleozoic Ammonoids, *F. B. Plummer.*

3. Physical Characteristics of the Bartlesville and Burbank Sands in Northeastern Oklahoma and Southeastern Kansas, *Constance Leatherock.*

4. Some New Species of the Genus *Graphiodactylus*, *L. A. Johnston.*

5. Extinction, an Aid in Correlation, *N. L. Thomas.*

6. Some Aspects of Classification of North American Fusulinids, *Maxim K. Elias.*

7. Graptolites of the Stringtown Shale and Basal Viola Limestone of Oklahoma and Womble Shale of Arkansas, *C. E. Decker.*

8. A Cambrian Graptolite Fauna in the Middle Arbuckle Limestone of Oklahoma, *C. E. Decker.*

9. The *Didymograptus protobifidus* Zone in the Arbuckle Mountains, Oklahoma and near Smithville, Arkansas, *C. E. Decker.*

10. Fusulinids from the Pennsylvanian and Permian Rocks of New Mexico and their Stratigraphic Significance, *C. E. Needham.*

11. The Chautauqua Arch and Pennsylvanian Sedimentation, *Norman D. Newell.*

12. Microscopic Fossils from an East Texas Oil Well, *Alice Quesenbery* and *J. A. Butts.*

13. Speed of Deposition of Glauconitic Sediments, *H. B. Stenzel* and *R. W. Cumley.*

At the conclusion of the morning meeting President Twenhofel appointed a Resolutions Committee consisting of F. B. Plummer (Chairman), Alva C. Ellisor, and N. L. Thomas, and asked the committee to report at the afternoon business session.

The paleontologists assembled at 12:30 for the annual luncheon, about 150 people being present. Charles Ryniker of the local committee acted as toastmaster. Mr. A. I. Levorsen, president of the Association, was the principal speaker. Talks were also made by E. O. Ulrich and W. H. Twenhofel.

The meeting was assembled at 2:00 P.M., and the following papers were presented:

14. On Some Large Oysters of the Gulf Coast Tertiary, *Henry V. Howe.*

15. Micro Faunal Range-Chart Involving an Eocene-Oligocene Section in South Texas-Northern Mexico, *H. L. Durgan* and *L. W. Callahan.*

16. Use of Corals in Jackson Eocene Well Cuttings, *M. M. Kornfeld.*

17. Some New Tertiary Textulariidae from Texas and Louisiana, *Cecil G. Lalicker.*

18. Shell Structure of the Ostracode Genus *Cytheridea*, *Morton B. Stephenson.*

19. Geological Research, Division of Foraminifera, *M. P. White.*

20. The Ammonites of the Trinity

Group, Exclusive of the Malone Formation, in Texas, Arkansas, and Louisiana, *Gayle Scott.*

21. Vertebrate Evidence of Jurassic in Cimarron County, Oklahoma, *J. W. Stovall.*

22. Insect Wings from the Nowata Shale, *Dan J. Jones.*

23. Devonian Mississippian Contact in South-Central Oklahoma, *E. B. Branson* and *M. B. Mehl.*

Business Session.—After a brief intermission President Twenhofel called the meeting into business session and business was transacted in the following order.

1. The President called for reading of the minutes of the previous meeting, but on motion carried unanimously this was omitted because the minutes have been published in the *Journal.*

2. President Twenhofel then gave his report.

3. Secretary-Treasurer Gayle Scott read the following report:

The membership of the Society of Economic Paleontologists and Mineralogists on March 15, 1936, numbered 198 active members and 77 associate members. Dues for 1936 were collected January 1, 1936. During the year, March 15, 1935, to March 15, 1936, the Society elected 8 new active members and 14 new associate members. Applications now pending number 6.

The Secretary has directed his energies toward maintaining and increasing the revenues of the Society through the sale of current and back numbers of the *Journal of Paleontology.* The total subscription list of Volume IX of the *Journal of Paleontology* amounts to 848. Of this 553 are S.E.P.M. subscribers. The total paid circulation of the *Journal of Sedimentary Petrology,* Volume V, amounts to 270. Schools, libraries, museums, laboratories have been canvassed for subscribers and members by the Secretary. A number of letters have been written to prospective advertisers soliciting advertisements and all of the present advertisers in the *Journal of Paleontology* have been notified of the new rates. The total advertising during the year amounted to approximately three pages yielding $153.59 revenue.

Both volumes of the 1935 issues of the Journals were printed by the George Banta Publishing Company at Menasha, Wisconsin. The full-tone plates in the *Journal of Paleontology* were printed by the Meriden Gravure Company at Meriden, Connecticut.

Altogether, Volume IX of the *Journal of Paleontology* contains 746 pages, 83 plates and was printed in lots of 1500 at a total cost to the S.E.P.M. of $2,841.29 ($3,093.76 less credit of $252.47 for authors' reprints during 1935). Volume V of the *Journal of Sedimentary Petrology* contains 152 pages and was printed in lots of 600 at a cost of $860.48.

The grants-in-aid received this year by the S.E.P.M. included $500.00 (A.A.P.G.) and $100.00 (National Research Council to be used on publication of the *Journal of Sedimentary Petrology*).

The present financial status of the Society is satisfactory as shown by the following statement:

Supplement to Cash Audit of Jan. 1, 1936

Cash on hand Jan. 1, 1935		$4,184.82
(This includes the Savings Acct. of $2,742.62)		
Receipts from Jan. 1 to Mar. 15, 1936	$1,788.34	
Expenditures from Jan. 1 to Mar. 15, 1936 ...	1,745.40	
		$ 42.94
Total amount of cash on hand March 15, 1936		$4,227.76

C. E. Decker moved that the report of the Secretary-Treasurer be accepted with appropriate commendation. The motion was seconded and carried by acclamation.

4. Reports were then made by the Editor-in-chief, Raymond C. Moore and the Editor of the *Journal of Sedimentary Petrology,* W. H. Twenhofel. The advisability of publishing four numbers of the *Journal of Sedimentary Petrology* was discussed by both editors.

Motion was made by C. E. Decker and

seconded that the Society accept the reports of the editors with great appreciation. The motion was carried by acclamation.

5. The President called for a report of the Committee on the Revision of the Constitution. The Committee was composed of Gayle Scott, chairman, F. B. Plummer, R. C. Moore, U. S. Grant, Jerry Upp, John E. Adams, Miss Alva C. Ellisor. Mr. Scott reported that the Committee had framed a revision, but that since this did not conform in certain respects to the Constitution of the Association it had not been possible to remove the discrepancies in time to present the revision to the annual meeting. He asked that the Committee be given additional time in which to complete the work of revision, and further asked that the Committee be authorized to obtain the approval of the revision by the Executive Committee of the Association, before presenting it to the Society. N. L. Thomas moved that the Committee on the Revision of the Constitution be authorized to continue its work of revision and have the revision ready to present to the Society at the next annual meeting. The motion was seconded and carried.

6. M. P. White spoke on the work being done by Professor Brooks F. Ellis in compiling essential data on all known species of foraminifera. He called attention to the fact that the work is being done by Ellis under a P.W.A. grant from the government, but that there are no funds available for the publication of the work. White proposed that we urge the printing of Professor Ellis' compilations on the foraminifera. He moved that the Society write to Doctor Ellis as follows:

Resolved that the Society of Economic Paleontologists and Mineralogists express their approval of the project known as Geological Research, Division of Foraminifera, under the direction of Doctor Brooks F. Ellis, having for its purpose the compilation of the pertinent data of all species of foraminifera; that the Society particularly urge that this material be made available in printed form as the most important step of the project; that a copy of this resolution be forwarded Doctor Ellis.

The motion was seconded and carried. R. W. Harris then arose to question the action that had been taken, stating that he feared the Society might become involved in undesirable political controversy. At the suggestion of White the question was again opened and there followed discussion by White, Harris, and H. V. Howe. The question was then again voted and carried, the Secretary being instructed to send a copy of the resolution to Professor Ellis.

7. The President asked the Secretary to announce the results of the election of officers. The Secretary reported that the ballots had been counted by the Council in accordance with the provisions of the by-laws. The following were declared duly elected officers of the Society for the year ending March, 1937:

President, Merle C. Israelsky.
Vice-President, R. W. Harris.
Secretary-Treasurer, Gayle Scott.
Editor, Raymond C. Moore.

8. A report of the Committee on Resolutions was called for by the President. The report as follows was read by N. L. Thomas:

Be it Resolved, That we, as members of the Society of Economic Paleontologists and Mineralogists, express our gratitude and appreciation of the many individuals and organizations who have contributed to the success of this Tulsa, Oklahoma, meeting, especially to the following:

1. To the American Association of Petroleum Geologists for its liberal grant to the *Journal of Paleontology*.
2. To A. I. Levorsen and the other officers of the Association for their hearty cooperation.
3. To Ira H. Cram and the program committee for the commodious accommodations for the Society meetings.

4. To Charles Ryniker and his committee for their untiring efforts.
5. To the Committee on Sedimentation of the National Research Council for its substantial grant to the *Journal of Sedimentary Petrology*.

During the past year the Society has sustained a great loss in the death of one of its most distinguished members, Doctor Carl Burckhardt, who has contributed so extensively to our knowledge of the Jurassic and Cretaceous stratigraphy and paleontology of Mexico.

F. B. Plummer, *Chairman*, Alva Ellisor, N. L. Thomas.

9. There being no further business, the meeting was adjourned.